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SURGERY AND THE BASIC SCIENCES

THE APPLICATION OF RECENT CONTRIBUTIONS IN BASIC MEDICAL SCIENCES TO SURGICAL PRACTICE

A. C. IVY, M.D., and J. S. GRAY, Ph.D., Chicago, Illinois

VITAMIN K AND OBSTRUCTIVE JAUNDICE

A long series of researches in basic medical sciences has in the past year apparently culminated in the solution of one of the most perplexing of clinical problems: the explanation and methods for the control of the hemorrhagic diathesis of jaundice. This series of researches began in 1929 when Dam (1) placed chicks on a synthetic diet containing only cod-liver oil as a source of the fat-soluble vitamins in order to conduct experiments on the cholesterol metabolism. It was noted that the chicks developed a syndrome characterized by severe subcutaneous and intramuscular hemorrhages and erosions of the lining of the gizzard. Although these symptoms suggested a deficiency of Vitamin C, Dam (2) was unable to control them by the administration of lemon juice. McFarlane, Graham, and Richardson (3) observed a similar hemorrhagic condition in chicks reared on an ether extracted diet. Blood from these animals was observed to remain uncoagulated when allowed to stand over night. Holst and Halbrook (4) made the same observation, but suspected a Vitamin-C deficiency, since the condition responded to the inclusion of cabbage in the diet. In 1934 Dam and Schonheyder (5) reported that cereals contained adequate amounts of a curative substance. Their finding that ascorbic acid and cod-liver oil failed to influence the hemorrhagic tendency definitely eliminated Vitamins A, D, and C. In addition to gross spontaneous hemorrhages the deficient chicks failed to grow normally and exhibited severe anemia. Since the most characteristic symptom appeared to be a loss of blood coagulability (spelled with a K in the Germanic languages), the new vitamin was given the name of Vitamin K. Subsequent investigation revealed that the gizzard erosions were due to the absence of an entirely different dietary factor.

Schonheyder (6) has shown that the enormous delay in coagulation time in chicks deficient in Vitamin K is not due to a disturbance in the fibrinogen, calcium, or cellular elements of the blood, or in the thrombokinase content of the tissues. Some constituent of normal blood plasma was absent, however, for the addition of normal plasma to the blood of bleeding chicks restored the coagulation time to normal. The deficient element in the coagulation process was shown by Dam, Schonheyder, and Tage-Hansen (7) to be prothrombin. Although Vitamin K itself could not behave *in vitro* as prothrombin, inconclusive evidence was obtained that Vitamin K might be a constituent of prothrombin, perhaps a prosthetic group of the prothrombin complex. By a more convenient and accurate method, which involved the same principles as Quick's method for the determination of prothrombin (*vide infra*), Schonheyder (8) has demonstrated an almost complete disappearance of prothrombin from the blood of chicks deficient in Vitamin K. According to the results of Dam, Glavind, Lewis, and Tage-Hansen (9) the intravenous or intramuscu-

lar injection of Vitamin-K concentrates in the form of an emulsion reduced the coagulation time within an hour. The vitamin was ineffective when administered subcutaneously unless it was dissolved in water with the aid of desoxycholic acid.

Vitamin K was reported by Dam (10) to be present in high concentration in hog liver and in certain seeds and green leafy vegetables, but to be absent from wheat-germ oil. The latter finding clearly differentiated it from Vitamin E. It was found to be a fat-soluble vitamin, present in the non-saponifiable but non-sterol fraction of extracts from potent sources. These findings in regard to the chemical behavior of the vitamin were confirmed promptly and independently by Almquist and Stokstad (11), who continued the investigations of Holst and Halbrook mentioned previously. Almquist (12) later prepared a material which underwent crystallization at low temperatures and which when added to the diet of chicks in quantities of from only 2 to 4 mgm. per kgm. of food protected chicks against deficiency symptoms. More recently Almquist and Klose (13) have prepared a crystalline derivative of Vitamin K by conjugation with cholic acid. The free vitamin is apparently an oily liquid at room temperatures. It has not yet been synthetized, nor has its chemical structure been elucidated.

The hemorrhagic tendency as a result of Vitamin-K deficiency was originally observed in chicks. Subsequently Dam, Schonheyder, and Lewis (14) produced the same symptoms in a variety of avian forms, but were unsuccessful in the case of rats, guinea pigs, and dogs. Almquist and Stokstad (15) (16) and Almquist, Pentler, and Mecchi (17) have shown that micro-organisms are capable of synthetizing the vitamin in food, in feces, or in pure culture. This may possibly account for the difficulty encountered in producing deficiency symptoms in mammalian forms. However, Murphy (18) has recently published a preliminary report which suggests that a hemorrhagic condition associated with delayed coagulation may be produced in mice by dietary means. Greaves (19) has recently reported that 12 of 77 rats maintained on a diet deficient in Vitamin K developed hemorrhagic symptoms associated with a low prothrombin level of the blood. The condition was corrected by the administration of Vitamin-K concentrates. Even when reared on a diet deficient in Vitamin K rats were found to eliminate the vitamin in the feces as a result of bacterial synthesis. Apparently, therefore, dietary means alone may suffice to produce the condition in occasional animals.

The real significance of Vitamin K for mammalian physiology and for clinical medicine was revealed by investigations along a different line. An enormous literature relative to the coagulation defect in the hemorrhagic diathesis of jaundice had accumulated. This work merely served to prove quite conclusively that bleeding in jaundice is in no way related to a disturbance in fibrinogen or calcium levels of the blood, to a deficiency in the formed elements of the blood, nor to any other easily studied component of the clotting mechanism. Until a few years ago the only available method for the determination of the prothrombin level of the blood was Howell's prothrombin time. Since this method consisted of determining the clotting time of recalcified plasma, it obviously was not specific for prothrombin. In view of this situation, Quick, Stanley-Brown, and Bancroft (20) in 1935 devised a more specific method for the determination of blood prothrombin, the only well-known element of the clotting mechanism which had not been adequately studied. In this method the most important variable, the thrombokinase, or platelet or tissue factor, is controlled by adding an excess of this substance to plasma before determining the coagulation time. By this method these authors were able to reveal a prothrombin deficiency in the blood of jaundiced patients exhibiting a hemorrhagic tendency. Warner, Brinkhous, and Smith (21) devised a still more accurate and specific method for the determination of the concentration of prothrombin in the blood. This method was applied by Hawkins and Brinkhous (22) to the study of the bleeding tendency which was previously observed to occur in dogs with chronic biliary fistulas. In such animals they observed a marked deficiency in the prothrombin level of the blood, which together with the bleeding could be prevented by returning bile to the intestinal tract.

In the meantime Greaves and Schmidt had been conducting a series of experiments revealing the necessity of bile for the adequate absorption of the fat-soluble Vitamins, A, D, and E. These investigators (23) observed a hemorrhagic tendency in their rats with bile fistulas and demonstrated that it was accompanied by a decrease in the blood-prothrombin level as determined by the method of Quick. The condition could be prevented by the oral administration of bile. By this time the existence of Vitamin K was becoming generally recognized and Greaves and Schmidt restored the normal level of prothrombin in the rats with bile fistulas by the administration of concentrates of the vitamin. Accordingly, the

evidence began to indicate that fat-soluble Vitamin K is required by mammals and that if bile, which is essential for its absorption, is absent from the intestine, deficiency symptoms quickly supervene.

Greaves (24) has recently confirmed and extended his findings in rats with bile fistulas and showed that bile is necessary for the absorption of Vitamin K, and that the bleeding tendency may be cured by the administration of bile if the diet contains Vitamin K, or by large doses of Vitamin K alone. Other vitamins were entirely ineffective. Smith, Warner, Brinkhous, and Seegers (25) have reported analogous results in dogs with bile fistulas, and Dam and Glavind (26) in chicks with bile fistulas.

Another factor has been shown to be of importance in the rôle of Vitamin K in the economy of the mammalian organism. Smith, Warner, and Brinkhous (27) have shown that mild liver damage, produced by the repeated administration of chloroform to dogs, lowers the blood prothrombin level and induces bleeding. Under these circumstances the blood fibrinogen is not reduced. Warner (28) has produced the same effects in rats by partial removal of the liver. Hepatic insufficiency of a degree sufficient to dangerously lower the blood prothrombin level leaves the fibrinogen concentration unaffected. The evidence therefore indicates that an adequately functioning liver is essential for the utilization of Vitamin K in the production of prothrombin.

The possible clinical applications of these results obtained by animal experimentation were quickly realized and appropriate investigations were undertaken by a number of workers. Quick (29) has demonstrated low blood-prothrombin levels in certain patients with jaundice or liver damage. Brinkhous, Smith, and Warner (30) have shown that the bleeding tendency in jaundice is accompanied by marked reduction in the blood-prothrombin concentration. They found that the administration of bile or of Vitamin-K concentrates restored normal blood values and corrected the tendency toward bleeding. Dam and Glavind (31) have also reported the successful treatment of bleeding in jaundice by the administration of Vitamin-K concentrates. Snell, Butt, and Osterberg (32) have confirmed these results and claim that active bleeding may be controlled by this therapy. The evidence appears to indicate that a determination of the blood-prothrombin level is a valuable indication of future bleeding in jaundiced patients and that Vitamin K and bile salts afford an effective therapeutic measure in the control of the condition.

In 1934, before Vitamin K had come into prominence, McNealy, Shapiro, and Melnick (33) reported that the administration of viosterol was effective in controlling the hemorrhagic diathesis of jaundice. The viosterol was given orally in conjunction with bile salts in those patients whose acholic stools betrayed the absence of bile from the intestine. This addition of bile salts may have augmented the absorption of Vitamin K as well as that of Vitamin D and thereby contributed to the effectiveness of the therapy. However, effective results were obtained in patients to whom bile salts were not administered. These results could not be attributed to an improved absorption of Vitamin K. Gray and Ivy (34) who studied the blood-calcium changes in these patients concluded that the most reasonable hypothesis which might be advanced to explain the effectiveness of viosterol was that it improved liver function. How this improved liver function was translated into a reduction of the bleeding tendency was completely unknown. However, if the beneficial effect of the viosterol were sufficient to enable the liver to utilize more efficiently the limited amounts of available Vitamin K so as to elevate the prothrombin concentration from a hemorrhagic level to a slightly higher level, the results could be explained. This is, of course, pure speculation and the future will have to reveal whether or not it is valid.

Recent investigations have suggested another clinical application of Vitamin K. Brinkhous, Smith and Warner (35) have reported that the blood-prothrombin level of infants is very low when compared with adult values. After the first several months of life, however, it approaches the adult level. In a case of hemorrhagic disease of the newborn the prothrombin concentration was found to be only 5 per cent of the adult level. A transfusion of adult blood significantly raised this value and resulted in the cessation of bleeding. Waddell, Guerry, Bray, and Kelley (36) have recently reported that the administration of Vitamin-K concentrates to two infants with very low prothrombin levels and prolonged coagulation time dramatically restored normal values. Vitamin K, therefore, may provide a simple and effective means for the control of hemorrhagic disease of the newborn.

A new factor which may have to be considered in the explanation of hemorrhagic tendencies has been pointed out by Warner, Brinkhous, and Smith (37). These investigators have found that the prothrombin level is quite constant in various mammalian species, but that man and the guinea pig differ from the others in that the prothrombin

is converted to the active thrombin at a much slower rate. This may account partially for the fact that the human species is so subject to the hemorrhagic diathesis.

Lichtman and Chambers (38) have isolated a sterol compound from liver which is chemically distinguishable from Vitamin K, but which is nevertheless claimed to be capable of restoring a normal coagulation time in chicks deficient in Vitamin K and in rats with bile fistulas.

A new preparation remarkably effective as a hemostatic agent for the control of bleeding during surgical procedures has been obtained by Seegers, Warner, Brinkhous, and Smith (39). These workers have made highly potent, sterile solutions of thrombin, which when sprayed on bleeding tissues almost instantly put an end to the bleeding. These solutions are effective in the control of bone bleeding without the use of wax.

VITAMIN P AND CAPILLARY FRAGILITY

It is widely accepted that an increase in the fragility of the capillaries is one of the earliest symptoms of Vitamin-C deficiency. However, an increased capillary fragility is not specific for this condition, for a large number of factors influence the resistance of the capillaries as determined by the positive-pressure or negative-pressure methods. Liebmann, Wortis, and Wortis (40) have been unable to demonstrate any accurate correlation between capillary fragility as determined by these methods and the level of ascorbic acid in the various body fluids. Nevertheless, claims have been frequently made that a variety of hemorrhagic tendencies accompanied by increased capillary fragility will respond to the administration of natural sources of Vitamin C. Armentano (41) was unable to confirm these reports when pure ascorbic acid was used. This suggested to Armentano, Bentsath, Beres, Rusznyak, and Szent-Gyorgyi (42) in 1936 that some active constituent in the natural sources of the vitamin, which is lost in the process of purification, might be responsible for controlling these purpuric tendencies. They found that crude preparations of Vitamin C were effective in the treatment of certain types of purpura which failed entirely to respond to ascorbic acid. The active constituent of these extracts was isolated in crystalline form as a mixture of flavone glucosides. To this substance they gave the name "citrin," or Vitamin P. The test subjects were observed visually for purpura; capillary resistance was measured by a suction method; capillary permeability was determined by the method of Landis. The administration of 40 mgm. of extract per day to patients who were abnormal with respect to these tests restored normal conditions. Thrombocytopenic purpura, however, was not improved by these measures. Bruckner and Szent-Gyorgyi (43) later identified the active flavones as hesperidine and eriodictyol glucoside.

Following these clinical observations attempts were made to provide experimental evidence from animals in support of the concept of the new vitamin. Bentsath, Rusznyak, and Szent-Gyorgyi (44) reported that guinea pigs maintained on a scorbutic diet lived somewhat longer, lost less weight, and exhibited less severe hemorrhages when citrin was made available to the animals. Both the control and citrin-treated animals, however, succumbed to scurvy. The same authors obtained similar results when the citrin was replaced by hesperidine (45). These results were quickly challenged, however, by Zilva (46), who could detect no effect from the administration of citrin or its component flavones. The ameliorative effects reported by Szent-Gyorgyi could be readily produced by the administration of subcurative doses of ascorbic acid. Neither Moll (47) nor Matussis (48) were able to influence the course of scurvy in guinea pigs by means of citrin. Bentsath and Szent-Gyorgyi (49) then revealed that their experiments had been repeated at their request in a number of independent laboratories with some successes and some failures. These discrepancies they attributed to the fact that citrin must contain traces of ascorbic acid to be effective. In fact, Bentsath and Das (50) claimed that the effect of citrin could be demonstrated only in animals which had received supplements of Vitamin C before being subjected to the scorbutic diet. Zilva (51) immediately pointed out that this factor could not have influenced his failure to confirm the effects of citrin. Accordingly, the animal experiments have failed to provide any evidence supporting the existence of the proposed vitamin. A method for studying this substance in animal experiments would be of great importance, but, as Robeznieks (52) has shown, the available methods for the detection of flavones are so insensitive as to preclude the possibility of constructing a flavone-free diet for animals.

Clinical investigation of the effects of citrin in hemorrhagic conditions has proceeded. Elmby and Warburg (53) have reported that occasional individuals with a hemorrhagic tendency associated with low ascorbic-acid levels in the blood fail

to respond to the administration of excessive amounts of ascorbic acid. Three such subjects studied, however, did respond to the ingestion of lemon juice with a rise of the ascorbic-acid content in the blood and disappearance of the bleeding tendency. Lajos (54) has found citrin to be effective in decreasing capillary fragility and permeability in "vascular" purpuras and hemorrhagic nephritides. Similar results have been claimed by Raunvert (55) and Lotze (56). Scarborough and Stewart (57) administered hesperidine to 6 patients with resulting improvement of the clinical condition and reduction of the capillary fragility. Three of these patients were exhibiting spontaneous petechial hemorrhages which had followed the administration of arsenic or bismuth.

Jersild (58) reported a case of a young woman with a typical case of Schonheim-Henoch purpura of many years' standing which failed completely to respond to intravenous ascorbic-acid therapy. Treatment with citrin, however, dramatically alleviated the symptoms and markedly improved capillary resistance. Withdrawal of the citrin produced relapses. The patient was later placed on a diet so deficient in Vitamin C that ascorbic acid all but disappeared from the blood, yet no return of symptoms occurred as long as citrin was regularly administered.

The present status of Vitamin P is by no means clear. Animal experiments have yielded no support for the existence of the vitamin. Clinical experience with the substance is not yet extensive enough to definitely establish its therapeutic or pharmacological activity. At the present time even elementary evidence to prove that citrin is a *vitamin* required by man or any other species is completely lacking. However, if the clinical trials continue to be sufficiently encouraging to stimulate interest in its investigation, experimental procedures will undoubtedly be devised to disclose its true nature.

LIPOCAIC

In a previous review of this series (59) the subject of choline and its relation to fat deposition in the liver was discussed. It was mentioned that Dragstedt, Van Prohaska, and Harms (60) had presented evidence to indicate that raw pancreas contained a factor in addition to choline which was capable of preventing or curing the fatty degeneration of the liver which is found typically in the depancreatized dog. Little more was said in regard to the theory which had been formulated on the basis of this finding, because at that time a lively controversy was in progress concerning it. Recently Dragstedt (61) has reviewed his evidence supporting the theory that this new factor obtainable from pancreas, called lipocaic, constitutes an internal secretion of this organ. It is well known that depancreatized dogs which do not receive raw pancreas in the diet develop a fatty liver. Dragstedt claims that this does not occur in dogs with ligated pancreatic ducts or with pancreatic fistulas and that the administration of pancreatic juice does not prevent the development of the liver changes in depancreatized dogs. For these reasons he claims that the external secretory function of the pancreas is not concerned with the development of the fatty liver; this condition results from the loss of an internal secretion of the pancreas separate from insulin which results from the complete removal of the organ. This internal secretion he has extracted from the pancreas in the form of a highly potent extract, lipocaic. His evidence that lipocaic does not consist of choline was that whole pancreas or extracts are much more effective than could be accounted for on the basis of their content of choline. However, Berg and Zucker (62) have reported that a fatty liver develops in dogs following ligation of the pancreatic ducts or construction of a pancreatic fistula. Ralli, Rubin, and Present (63) have more recently reported similar results. If these findings are valid they present a serious obstacle to the hormone theory of the etiology of the fatty liver. They would suggest that the external secretions of the pancreas are involved. Criticism from another angle soon appeared. Although MacKay (64) reported that the effect of pancreas extracts in preventing the development of fatty livers in rats maintained on a high fat diet was greater than could be accounted for on the basis of the choline present, MacKay and Barnes (65) subsequently denied this. Aylward and Holt (66) and Best and Ridout (67) also concluded that the only active constituent of raw pancreas or pancreas extracts was choline, as determined in rats. However, more recently Channon, Loach, and Tristram (68) have conducted a very careful and extensive series of experiments in rats in which they point out the errors of the previous investigators and conclude from their own work that pancreas extracts do contain a factor in addition to choline, which is effective in preventing the development of dietary fatty livers in rats. Dragstedt, Donovan, Goodpasture, and Geer (69) answered some of these criticisms by preparing extracts of lipocaic which

were effective in amounts which contained only traces of free choline. Clark, Vermeulen, Donovan, and Dragstedt reported this spring at the meetings of the American Physiological Society that they had been able to prepare extracts which were effective in daily doses of less than 100 mgm., which are much less than the necessary dose of pure choline. Although the evidence supporting the view that lipocaic is an internal secretion of the pancreas is by no means complete, the evidence showing that lipocaic is not choline and that it is effective in preventing the deposition of fat in the liver of depancreatized dogs is fairly convincing.

The fact that lipocaic is effective in preventing the abnormal deposition of fat in the liver has suggested its possible usefulness in preventing the deposition of lipoid material in atheromas of the aorta in rabbits maintained on a high cholesterol diet. That lipocaic is effective in preventing this pathological change has been reported by Huber, Brown, and Casey (70). Choline has been reported by Baumann and Rusch (71) to be ineffective and by Steiner (72) to be only slightly effective in preventing this aortic degeneration.

Some rather suggestive experiments have been recently reported by Swanson and Nelson (73). These investigators have found that rats maintained on a presumably adequate diet containing dried canned pork as a source of protein suddenly develop toxemia with convulsions during pregnancy. The livers of these animals were found to be friable and fatty. It was found that fresh liver protected the animals against the condition, but that choline or lecithin proved to be of no benefit. Lipocaic in quantities of only 4 mgm. per day was discovered to be fully protective.

Very little clinical work has as yet been done with choline or lipocaic, in spite of the fact that the therapeutic possibilities are quite inviting. Grayzel and Radwin (74) reported the successful reduction of the size of the liver by the administration of lipocaic in 3 cases of juvenile diabetes with hepatomegaly. Snell and Comfort (75) have reported that choline produced a reduction in the size of the liver and an improvement, as shown by dye-retention tests, in a case of fatty liver associated with extensive destruction of the pancreas. Stoesser (76) has noted a decrease in the blood lipids in children at the height of acute infections and during convalescence. The administration of raw or desiccated pancreas to such children resulted in an elevation of the blood-lipid levels, much as occurs under the same circumstances in depancreatized dogs. The most completely studied case yet reported is that of Rosenberg (77). At operation a liver biopsy specimen taken from a female patient revealed severe fatty metamorphosis, which from clinical evidence had been present for a period of months. The daily administration of lipocaic to this patient produced marked clinical improvement. The necessity of performing an operation for the removal of gall stones permitted the securing of a second biopsy specimen which revealed a complete return to normal.

BIBLIOGRAPHY

1. Dam. Biochem. Ztschr., 1929, 215: 475.
2. Idem. Biochem. Ztschr., 1930, 220: 258.
3. McFarlane, Graham, and Richardson. Biochem., J., 1931, 25: 358.
4. Holst and Halbrook. Science, 1933, 77: 354.
5. Dam and Schonheyder. Biochem. J., 1934, 28: 1355.
6. Schonheyder. Nature, 1935, 135: 652.
7. Dam, Schonheyder, and Tage-Hansen. Biochem. J., 1936, 30: 1075.
8. Schonheyder. Am. J. Physiol., 1938, 123: 349.
9. Dam, Glavind, Lewis, and Tage-Hansen. Skandin. Arch. f. Physiol., 1938, 79: 121.
10. Dam. Biochem. J., 1935, 29: 1273.
11. Almquist and Stokstad. J. Biol. Chem., 1935, 111: 105.
12. Almquist. J. Biol. Chem., 1937, 120: 635.
13. Almquist and Klose. J. Am. Chem. Soc., 1939, 61: 745.
14. Dam, Schonheyder, and Lewis. Biochem. J., 1937, 31: 17.
15. Almquist and Stokstad. J. Biol. Chem., 1935, 111: 105.
16. Idem. J. Nutrition, 1936, 12: 329.
17. Almquist, Pentler, and Mecchi. Proc. Soc. Exper. Biol. & Med., 1938, 38: 336.
18. Murphy. Science, 1939, 89: 203.
19. Greaves. Am. J. Physiol., 1939, 125: 429.
20. Quick, Stanley-Brown, and Bancroft. Am. J. M. Sc., 1935, 190: 501.
21. Warner, Brinkhous, and Smith. Am. J. Physiol., 1936, 114: 667.
22. Hawkins and Brinkhous. J. Exper. M., 1936, 63: 795.
23. Greaves and Schmidt. Proc. Soc. Exper. Biol. & Med., 1937, 37: 43.
24. Greaves. Am. J. Physiol., 1939, 125: 423.
25. Smith, Warner, Brinkhous, and Seegers. J. Exper. M., 1938, 67: 911.
26. Dam and Glavind. Acta med. Scand., 1938, 96: 108.
27. Smith, Warner, and Brinkhous. J. Exper. M., 1937, 66: 801.
28. Warner. J. Exper. M., 1938, 68: 831.
29. Quick. J. Am. M. Ass., 1938, 110: 1658.
30. Brinkhous, Smith, and Warner. Am. J. M. Sc. 1938, 196: 50.
31. Dam and Glavind. Lancet, 1938, 1: 720.
32. Snell, Butt, and Osterberg. Am. J. Digest. Dis. 1938, 5: 590.
33. McNealy, Shapiro, and Melnick. Surg., Gynec. & Obst., 1935, 60: 785.
34. Gray and Ivy. Am. J. Digest. Dis., 1935, 2: 368.
35. Brinkhous, Smith, and Warner. Am. J. M. Sc., 1937, 193: 475.
36. Waddell, Guerry, Bray, and Kelley. Proc. Soc Exper. Biol. & Med., 1939, 40: 432.
37. Warner, Brinkhous, and Smith. Am. J. Physiol.. 1939, 125: 296.

38. LICHTMAN and CHAMBERS. Science, 1938, 88: 358.
39. SEEGERS, WARNER, BRINKHOUS, and SMITH. Science, 1939, 89: 86.
40. LIEBMANN, WORTIS, and WORTIS. Am. J. M. Sc., 1938, 196: 388.
41. ARMENTANO. Ztschr. f. klin. Med., 1936, 129: 685.
42. ARMENTANO, BENTSATH, BERES, RUSZNYAK, and SZENT-GYORGYI. Deutsche med. Wchnschr., 1936, 62: 1325.
43. BRUCKNER and SZENT-GYORGYI. Nature, 1936, 138: 1057.
44. BENTSATH, RUSZNYAK, and SZENT-GYORGYI. Nature, 1936, 138: 798.
45. Ibid., 1937, 139: 326.
46. ZILVA. Biochem. J., 1937, 31: 915.
47. MOLL. Klin. Wchnschr., 1937, 16: 1653.
48. MATUSSIS. Bull. Biol. Med. Exper., U.R.S.S., 1937, 4: 481.
49. BENTSATH and SZENT-GYORGYI. Nature, 1937, 140: 426.
50. BENTSATH and DAS. Ztschr. f. physiol. Chem., 1937, 247: 258.
51. ZILVA. Biochem. J., 1937, 31: 1488.
52. ROBEZNIEKS. Ztschr. f. Vitaminforsch., 1938–39, 8: 27.
53. ELMBY and WARBURG. Lancet, 1937, 2: 1363.
54. LAJOS. Klin. Wchnschr., 1937, 16: 1615.
55. RAUNVERT. Ztschr. f. Urol., 1938, 32: 630.
56. LOTZE. Ztschr. f. d. ges. exper. Med., 1938, 102: 696.
57. SCARBOROUGH and STEWART. Lancet, 1938, 2: 610.
58. JERSILD. Lancet, 1938, 1: 1445
59. IVY. Internat. Abstr. Surg., 1938, 66: 403.
60. DRAGSTEDT, VAN PROHASKA, and HARMS. Am. J. Physiol., 1936, 117: 175.
61. DRAGSTEDT. Northwest Med., 1938, 37: 33.
62. BERG and ZUCKER. Proc. Soc. Exper. Biol. & Med., 1931, 29: 68.
63. RALLI, RUBIN, and PRESENT. Am. J. Physiol., 1938, 122: 43.
64. MACKAY. Am. J. Physiol., 1937, 119: 783.
65. MACKAY and BARNES. Proc. Soc. Exper. Biol. & Med., 1938, 38: 410.
66. AYLWARD and HOLT. J. Biol. Chem., 1937, 121: 61.
67. BEST and RIDOUT. Am. J. Physiol., 1938, 122: 67.
68. CHANNON, LOACH, and TRISTRAM. Biochem. J., 1938, 32: 1332.
69. DRAGSTEDT, DONOVAN, GOODPASTURE, and GEER. Am. J. Physiol., 1938, 123: 54.
70. HUBER, BROWN, and CASEY. Proc. Soc. Exper. Biol. & Med., 1937, 37: 441.
71. BAUMANN and RUSCH. Proc. Soc. Exper. Biol. & Med., 1938, 38: 647.
72. STEINER. Proc. Soc. Exper. Biol. & Med., 1938, 38: 23; 1938, 39: 411.
73. SWANSON and NELSON. J. Nutrition, 1938, 15: 19.
74. GRAYZEL and RADWIN. Proc. Soc. Exper. Biol. & Med., 1938, 37: 724.
75. SNELL and COMFORT. Am. J. Digest. Dis., 1937, 4: 215.
76. STOESSER. Proc. Soc. Exper. Biol. & Med., 1939, 40: 202.
77. ROSENBERG. Am. J. Digest. Dis., 1938, 5: 607.

ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Rowbotham, G. F.: Epidermoids Arising in the Diploë of the Bones of the Skull. *Brit. J. Surg.*, 1939, 26: 506.

An epidermoid is a neoplasm which arises in ectodermal cell rests. These may become enclosed within the tables of the calvarial bones. Both skin and brain arise originally in the same ectodermal cell plate and are later separated by the ingrowth of mesodermal elements from the lateral cell mass.

The neoplasm now known as an epidermoid was originally described by pathologists as *tumeur perlée*, which describes its glistening capsule. It was also called cholesteatoma, an undesirable term because it embraces dermoids, epidermoids, and endotheliomas, as well as the non-neoplastic cheesy débris which forms in the mastoid air cells in chronic inflammatory processes.

Two epidermoids arising in the diploë of the frontal and occipital bones of the skull are described. In neither case did the neoplasm cause compression of the brain; in the frontal bone the outer table only had entirely disappeared. To prevent recurrence, complete removal or destruction of the epithelial capsule is essential. MANUEL E. LICHTENSTEIN, M.D.

EYE

Sanders, T. E.: Mixed Tumor of the Lacrimal Gland. *Arch. Ophth.*, 1939, 21: 239.

Diseases of the lacrimal gland are so rare as to be clinical curiosities. The most common pathological condition affecting the lacrimal gland is undoubtedly tumor. However, there are several inflammatory diseases of the gland. Acute dacryoadenitis is a well known, though rare, entity, usually caused by mumps, but often caused by the Koch-Weeks bacillus. Tuberculous dacryo-adenitis and fungus infection of the gland have been reported. Bilateral symmetrical enlargement of the lacrimal and salivary glands have long been known as Mikulicz disease. This probably is merely a syndrome caused by chronic inflammatory infiltration of the gland by such processes as leucemia, tuberculosis, and syphilis, although in some instances the condition may be a true clinical entity. Atrophy of the lacrimal gland in association with xerophthalmia from Vitamin-A deficiency has been thought to be a factor in the production of the ocular symptoms; dislocations and cysts of the lacrimal gland or dacryops have been described as clinical entities.

A series of 12 cases of mixed tumor of the lacrimal gland is reported. Ten of the patients were followed up for a period of at least two years. The symptoms are those of a slowly progressive orbital tumor, and consist of exophthalmos, diplopia, limitation of motion, loss of vision, and a palpable mass in the region of the lacrimal gland, which is a constant and an almost diagnostic finding.

In 10 (91 per cent) of 11 patients in whom surgical treatment was employed, there was a recurrence. One patient who refused operation died in six years with marked local invasion and metastases to the liver, lung, and mediastinum. Four (33 per cent) of the patients had metastases. Five (42 per cent) are dead from intracranial extension due to a marked tendency toward bony invasion. Clinically, the growths in these cases should probably be considered malignant.

Histologically, the growths seem identical with mixed tumors of other locations, as described in the literature. The invasive element seems to be the epithelium. The recurrence is probably due to incomplete removal because of the difficulty of surgical approach and the tendency toward early bony invasion. Pathologically, the mixed tumors are probably a definite entity of dual origin, the epithelial element of which has a characteristic tendency to become locally invasive.

As irradiation is of little aid, early complete surgical removal is indicated. The local removal should be more radical than that usually done. If there is evidence of bony invasion, either roentgenographically or clinically, a resection of the entire tumor-bearing area is indicated, but if the invasive tumor is limited to the soft tissues, exenteration may be sufficient. LESLIE L. MCCOY, M.D.

Wheeler, J. M.: Correction of Ptosis by Attachment of Strips of Orbicularis Muscle to the Superior Rectus Muscle. *Arch. Ophth.*, 1939, 21: 1.

Wheeler describes his modification of the Motais type of operation for ptosis, in which the superior rectus muscle is used to elevate the upper lid. After incision and dissection of the skin of the upper lid, two strips of orbicularis muscle are prepared parallel to the lid margin and with the free ends toward the canthi. These are passed through an incision in the orbicularis muscle, tarso-orbital fascia, and levator tendon 4 or 5 mm. above the tarsus and sutured to the superior rectus on its upper surface. The attachment is made with 000 chromic catgut. No other suture is required except for the skin.

No overcorrections have been obtained. The only objection to the operation, in the opinion of the author, is that the dissection might be considered difficult. This type of operation has many advantages and may overcome many of the objections to the Motais operation. WILLIAM A. MANN, M.D.

Barkan, O.: An Operative Procedure for Glaucoma of the Shallow-Chamber Type: Multiple Excisions of the Root of the Iris and Deepening of the Anterior Chamber. *Arch. Ophth.*, 1939, 21: 331.

Primary glaucoma may, with few exceptions, be divided into two anatomical types according to the mechanical cause of the increased intra-ocular pressure. One type is characterized by a normal or deep chamber and an open iridic angle in which the increased pressure is caused by blockage of the sclerocorneal trabeculum. The second type is characterized by a shallow chamber and a narrow angle and is produced by obstruction of the filtration angle by the root of the iris.

In the treatment the pupil should be contracted with a miotic, and local preparation should be made in the same manner as for any intra-ocular operation. Akinesis should be secured in the usual way. Local anesthesia is obtained by instillation of drops of 1 per cent pontocaine hydrochloride.

Four per cent procaine hydrochloride (without epinephrine) is injected into the superior rectus muscle, and 1 c.cm. of a 4 per cent solution of procaine hydrochloride with the addition of 1 drop of epinephrine hydrochloride (1:1000) is injected retrobulbarly. The speculum is inserted.

The technique of posterior sclerotomy is as follows:

In cases in which the vitreous is liquid or in those in which the pressure is not too high, posterior sclerotomy facilitates subsequent deepening of the anterior chamber by means of injection. In some cases in which the vitreous pressure is very high or in those in which the vitreous is not fluid, posterior sclerotomy does not soften the eyeball nor does it facilitate the subsequent deepening, since no vitreous has been lost. In these cases and in those in which the chamber is very shallow and a malignant course threatens, aspiration of 0.5 c.cm. of vitreous with a zur Nedden needle, with a lumen of 0.6 or 0.7 mm., inserted toward the center of the bulbus may be advantageously employed. It softens the eyeball but does not in itself deepen the anterior chamber appreciably.

The anterior chamber is deepened by means of an injection of physiological solution of sodium chloride, until the iris diaphragm is pushed well back. An incision with a sharp keratome is then made, beginning not more than 1 mm. scleral to the corneoscleral border.

Three successive keratome incisions and peripheral iridectomies are performed. It is usually found necessary to deepen the chamber with an injection of saline solution after the completion of each iridectomy (Fig. 1).

The pupil should be miotic during the first week after operation in order to keep the root of the iris out of the angle.

The procedure described in this article appears to solve the technical difficulties and dangers of operation in cases of the shallow-chamber type of chronic primary glaucoma. It reduces increased intra-ocular pressure by restoring and maintaining the physiological direction of the outflow of the aqueous. There is no cosmetic disfigurement, nor is appreciable refractive error caused. The sphincter of the pupil is preserved. It prevents postoperative adhesions in the filtration angle. It seems to be practically free of the dangers of present-day operations, such as iritis, late infection, cataract formation, and other disturbing sequelæ and complications. It avoids the danger of a malignant course. To judge from the limited number of cases (15) in which operation has been performed to date, it gives promise of adequately answering the purpose of an early or prophylactic operation of this type of glaucoma. LESLIE L. MCCOY, M.D.

Fig. 1. Appearance of eye one year after operation.

Sorsby, A.: Vital Staining of the Retina (Preliminary Clinical Note). *Brit. J. Ophth.*, 1939, 23: 20.

A large number of basic dyes, such as gentian violet and other blue and green dyes, were tried experimentally in rabbits in an effort to stain the retina. Any staining of the fundus was so transitory as to be doubtful and invariably the animals collapsed when any suggestive staining was obtained. To overcome the inherent toxicity of the basic dyes a study was made of a number containing sulfonic-acid radicles, sulfonation being one way of reducing the toxicity. Rhodamin dyes were also studied. The first satisfactory results were obtained by Light Green S.F., a sulfonated triphenylmethane dye, and Fast-Acid Violet, a rhodamine dye. They were not highly toxic and gave satisfactory staining of the brain of the intact animal; however, staining of the retina was only transitory. As it has been shown that basic dyes are reduced to the leucobase in the eye, experimental degeneration of the retina was induced; intense staining of the retina lasting for several hours was then obtained.

In clinical work Kiton Fast Green V was used after preliminary toxicity tests on monkeys. A 10

per cent solution of the dye was prepared and sterilized, and from 20 to 30 c.cm., warmed to body temperature, were injected intravenously. After the first 3 or 4 c.cm. the patient assumed a faint greenish color which deeped as the injection proceeded and continued up to one-half hour, and began to fade in 3 or 4 hours. The dye was excreted mainly through the kidneys, the urine remaining colored for two or three days.

Choroidal or retinal exudates stain deeply. The retina in optic atrophy does not stain with the dose used to date. In some cases of retinal detachment additional tears were visualized because of the staining around them.

The author makes few claims except for a demonstration of the feasibility of vital staining of the retina. WILLIAM A. MANN, M.D.

MOUTH

Brown, J. B.: The Management of Compound Injuries of the Face and Jaws. *South. M. J.*, 1939, 32: 136.

The term "compound injuries of the face" may be used to designate any serious facial injury to soft tissue or bone. Automobile injuries are often of this type and are often as bizarre as those of firearm injuries. There may be cranial and cervical-spine injuries complicating the facial injury, and neurological and roentgenological examination should be made.

Shatterproof glass offers a resistance that may produce markedly comminuted fractures with little laceration of the surface but often with widespread avulsion of the scalp. If the glass does break, the most clean-cut wound of soft parts, bone, and cartilage may occur; and when once broken the glass may leave many chips that may get into the wound.

In extensive injuries it may be best to wait until the patient is in the operating room before manipulation of the tissues simply to find the extent of the injury. There should be a recording of the loss or tearing of all the features, the extent of detachment from the bones; and then, in regard to the preservation of function, any occlusion of the airway, loss of vision, or facial paralysis should be noted.

Dirt and foreign bodies as clothing must be removed, and it may be helpful to know the type of dirt or street into which the patient has been thrown. Antitetanus and gas-gangrene serums are given when indicated.

Roentgenograms should be taken in all fractures and particularly in those cases of questionable fracture.

It is best to care for these wounds and fractures in the first twelve to twenty hours if possible, before swelling, organization of the clots, and infection have occurred. If seen later, then manipulation of the fractures can be delayed, but the soft parts may still be approximated. Delay in treatment is necessary if there is neurological damage that requires care or complete rest, or if shock is present. If the patient is intoxicated, no jaw-to-jaw fixation should be done until he is recovering and is not apt to vomit.

Anesthesia can be basal or local or nerve-block. General anesthesia is to be avoided, but is often necessary in children.

Cleaning of the wound is the most important consideration and may include saline irrigations; soap and water cleansing (ether as a solvent if necessary), the removal of hair, bits of clothing, all possible foreign bodies, and detached chips of bone; and finally the application of an antiseptic, if one is preferred. The decision of when to clean and when to give the anesthesia is difficult but a simple rule is to clean as far as possible with the patient enduring the pain, and then to give local or general anesthesia when it is necessary.

Meticulous cleansing should almost entirely constitute the débridement of a face; and, if necessary, it should be practiced carefully so that parts of features will not be sacrificed.

The next step is the replacement and fixation of bone, and a few methods are cited. External dependent drainage should be considered in all patients. If the nasal airway is occluded, it can be reestablished by means of a good-sized rubber tube being slipped through; other bone replacement should then be done, as elevation of the orbits and the nose. The same conservation of bone should be practiced as for soft parts.

For suturing of the soft parts new cleansing can be done and fresh instruments used if the mouth secretions can now be avoided. In complicated tears a design for closure may be difficult, but a start should be made from a known point, as a lip or nostril border. Deep fine silk sutures may be placed so that the wound edges are closed before any other skin sutures are inserted. Uneven edges, if viable, are carefully replaced to avoid any unnecessary loss of tissue.

Large or small trap-door flaps often give bad final scars because of the tendency of the circular base to contract, and the wounds should be closed carefully with especial provision to prevent blood clots under them.

Small drains are used at suitable dependent areas if the necessity is at all apparent. Careful dressings, with marine sponges or mechanic's waste for pressure to control hemorrhage and swelling, and thereby infection, are extremely important. The patient is usually most comfortable with a large firmly supporting bandage. HARVEY S. ALLEN, M.D.

PHARYNX

White, F. W., and Hubert, L.: Parapharyngeal Hemorrhage: Diagnosis and Treatment. *Arch. Otolaryngol.*, 1939, 29: 1.

Although many specialists in diseases of the ear, nose, and throat have been fortunate enough not to have had any harrowing experiences with fatal or nearly fatal hemorrhage, or fatality following septic thrombosis of the internal jugular vein, this good

fortune is no guarantee for the future. To Mosher, in this country, is due much of the present interest in the parapharyngeal (pharyngomaxillary) space and its inflammatory diseases.

The authors analyze 6 cases of pharyngomaxillary infection from which they arrive at several thoughtful conclusions. They believe that the degree of infectivity of the causative organisms for a given person determines the seriousness of the pharyngomaxillary invasion. In many instances conservative treatment of pharyngomaxillary infection is successful. Every effort should be made to determine the status of the nerves in the pharyngomaxillary space, since such knowledge may aid in making a diagnosis. When the condition is doubtful, the nerves may confirm the suspicion that pharyngomaxillary infection exists.

Free, active hemorrhage from the throat, with or without apparent inflammation, requires not local treatment but bold external operative measures. While fatal hemorrhage occurs comparatively infrequently, still it occurs too frequently. Many patients die from unannounced, sudden, overwhelming, but avoidable hemorrhages. Meddlesome incision of a lateral pharyngeal swelling may lead to hemorrhage. If the condition is treated conservatively, ligation may not be necessary. Aural hemorrhage associated with pharyngomaxillary infection requires immediate ligation of the common carotid artery.

If any doubt exists regarding erosion of the internal carotid artery, the external carotid and the ascending pharyngeal arteries should be ligated and a loose ligature placed around the common carotid artery. Ligation of the common carotid artery, when it is done slowly (in minutes, not seconds) and with an attempt actually to prevent the flow of blood beyond the ligature, not just to feel the severance of the intima, is a life-saving operation, as compared to temporizing methods of operation by the intrapharyngeal route.

Hemorrhages from the throat and the ear associated with trismus, involvement of the nerves, lateral pharyngeal tumefaction, sepsis and swelling, and tenderness of the corresponding side of the neck indicate infection of the pharyngomaxillary fossa.

NOAH D. FABRICANT, M.D.

NECK

Thompson, W. O.: The Hypothyroid States. *Med. Clin. North Am.*, 1939, 23: 175.

Primary hypothyroidism is caused largely by destruction of thyroid tissue and the symptoms are relieved by the use of desiccated thyroid. Secondary hypothyroidism is due to inadequate stimulation of the thyroid gland, especially by the anterior lobe of the pituitary gland, and possibly also by the adrenal cortex. Desiccated thyroid relieves only a part of the syndrome. In starvation and nephrosis the basal metabolism may be markedly lowered in a manner not clearly understood. Slight lowering of the basal metabolism occurs rarely in normal individuals after the administration of iodine. After a subtotal thyroidectomy for hyperthyroidism when the metabolism is normal or only slightly elevated, iodine may occasionally cause a marked lowering and signs of myxedema. Certain other patients with low basal metabolism do not fit definitely into any clinical group and are not improved by treatment with thyroid substance.

Basal metabolism may be regulated by mechanisms other than the thyroid hormone, as for example, epinephrine, dinitrophenol, dinitro-orthocresol and di-iodothyronine. Each produces its effect at a different rate and presumably, therefore, by a different mechanism.

Determination of the level of metabolism is always important, but a single test may not be reliable. Basal rates consistently below −15 per cent are usually, but not always, associated with some pathological disturbance.

The first and most important step in the management of a patient with a low basal metabolism is a decision as to the presence or absence of hyperthyroidism. This may be considered to exist if desiccated thyroid or thyroxine, in a suitable dose, improves the clinical condition. The ideal method of treatment is to raise the metabolism gradually to normal with slowly increasing doses of desiccated thyroid until the minimum amount is being given that will maintain the basal metabolism at a normal level. In the treatment of hypothyroidism associated with Froehlich's syndrome and some cases of Simmonds' disease, a combination of desiccated thyroid and the principle from the urine of pregnant women similar to that of the anterior pituitary lobe, and suitable dietary measures may produce marked improvement. In patients with Addison's disease receiving maintenance doses of adrenal cortex extract, associated hypothyroidism is relieved by the use of desiccated thyroid.

WALTER H. NADLER, M.D.

Negus, V. E.: The Differential Diagnosis of Intrinsic Carcinoma of the Larynx. *Arch. Otolaryngol.*, 1939, 29: 223.

Negus reviews the diseases which most commonly cause confusion in a differential diagnosis of intrinsic carcinoma of the larynx. Not only is there danger that treatment, by operation or otherwise, may be instituted under a mistaken diagnosis of malignant disease, but there is even greater danger that malignant change may be overlooked until the disease has progressed beyond the chance of cure. He therefore discusses chronic simple laryngitis, hypertrophic laryngitis, hyperkeratosis and pachyderma, syphilitic infiltration and leucoplakia, tuberculous laryngitis, and simple neoplasm.

In long-standing or progressive hoarseness the signs may be those of chronic inflammation. The whole larynx may be inflamed, and the aryepiglottic folds, if involved, may appear thickened and infiltrated. The vocal cords lose their luster and the margins appear rounded and thickened. In such

cases nasal obstructions, or chronic inflammatory changes in the nose, sinuses, mouth, or pharynx, are treated. Smoking should be abandoned, the use of alcohol kept within limits, and the use of the voice reduced or avoided altogether.

Hypertrophic laryngitis may occur as diffuse infiltration of the vocal cords and ventricular bands. There may be a localized tuberosity over the vocal process, or a heaping-up in the interarytenoid region, or, finally, an isolated plaque of keratosis may be present, particularly on the anterior third of one vocal cord. Localized or diffuse overproduction of the superficial epithelium causes considerable difficulty in deciding whether malignant changes are commencing in the deeper layers of what is a potentially precancerous condition. A progressive change in appearance, or an increase of symptoms gives warning that a simple process, possibly present for years, is changing its character. Biopsy may be required to settle the question as to whether drastic treatment is required.

Syphilitic disease of the larynx is such a rarity that its exclusion is probable in practically all cases. Occasionally a patient with hyperkeratosis of long standing, presumably associated with syphilis, may be seen. An aid to diagnosis is the observation that syphilitic foci are multiple and thus differ from malignant neoplasms, which are single; also, syphilis usually is found to affect the pharynx as well as the larynx.

Tuberculous laryngitis may show itself as diffuse and irregular thickening of the whole of one cord, even with fixation, but usually there is suspicious ulceration over the vocal process or in its neighborhood; there may be associated pseudo-edematous swelling of the aryepiglottic fold. Neither the history nor physical examination may give any suggestion that the lungs are involved, but roentgen examination should show deposits if any are present. In cases of doubt, biopsy will be required. Occasionally a suspicion of tuberculosis may arise in a case in which the correct diagnosis is carcinoma. Here again biopsy may be required.

It is sometimes possible for a simple neoplasm to produce signs and symptoms suggestive of malignant disease. Chondroma of the cricoid cartilage and, especially, papilloma in an adult may simulate malignant disease. During the healing process after treatment of carcinoma of the larynx by operation or irradiation, simple granuloma may appear either at the anterior end of the excavation left by operation, or near the anterior commissure after interstitial irradiation.

Negus warns against the misleading results of biopsy. He cites the danger that wrong conclusions may be drawn when, in removing a portion of tissue for microscopic examination, the surgeon has not gone deep enough to embrace the cancerous area. Biopsy should afford a guide as to whether laryngofissure, total laryngectomy, interstitial irradiation, or teleradiation is indicated.

NOAH D. FABRICANT, M.D.

Crowe, S. J., and Broyles, E. N.: Carcinoma of the Larynx and Total Laryngectomy. *Ann. Otol., Rhinol. & Laryngol.*, 1938, 47: 875.

Of the two methods of treating carcinoma of the larynx, irradiation with roentgen rays or radium and surgical removal, the first procedure is very valuable in the treatment of malignant growths, but should be used only in inoperable cases or to supplement operative removal. At the present time the results of ray therapy are so erratic and uncertain that whenever the diagnosis of cancer has been established and the growth is found to be still localized and safely removable the operation should not be postponed. There are, however, many patients with inoperable conditions. The authors believe that until the results of X-ray or radium treatment are more consistent and encouraging in the latter cases an operable new growth in the larynx should never be treated with irradiation alone.

In the second method, surgical removal, the general principles of the operation are the removal of the growth with an adequate margin to insure against recurrence and to preserve the voice and the normal channels for breathing and swallowing as much as possible. In carefully selected cases laryngofissure is the operation of choice. By laryngofissure the authors mean the removal in one piece of the affected vocal cord, including its attachment to the arytenoid cartilage, the entire anterior commissure area, and a large portion of the thyroid cartilage. Removal by the laryngofissure route is contraindicated if the growth involves the anterior commissure, has fixed the true cord, or has spread

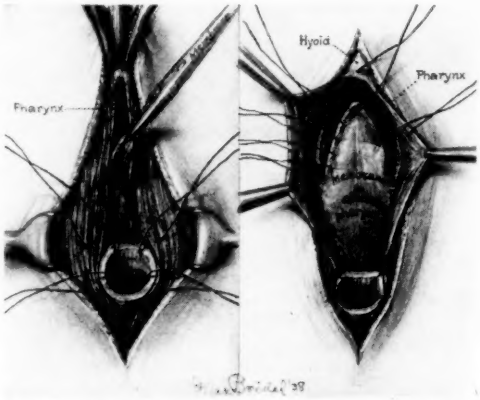

Fig. 1. The most important feature of the operation is shown on the right: interrupted chromic catgut sutures (size oo) include the mucous membrane flap, the mucous membrane of the pharynx, and a little of the under surface of the sternohyoid muscle. When tied the muscle covers the line of incision and prevents leakage of saliva or food into the neck wound. To get this result, however, the wound must be closed without tension of any of the sutures.

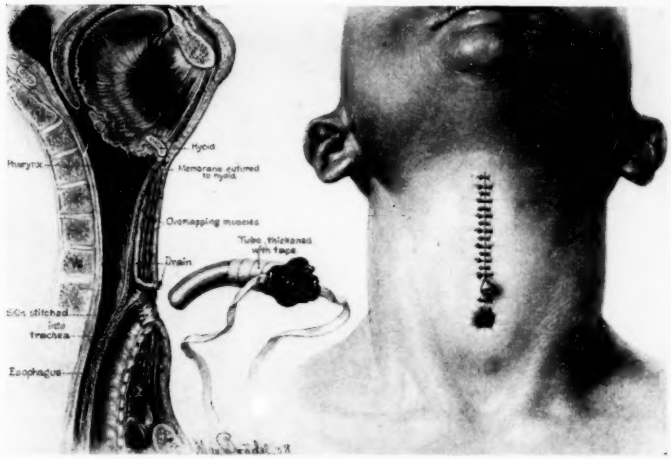

Fig. 2. The wound is closed but the skin incision must be opened at the first sign of infection. If there is no infection the rubber tissue drain is gradually withdrawn and removed entirely on the third day. If the tracheal opening ever becomes too small the skin around the lower half is elevated and the underlying anterior wall of the trachea removed with a high frequency cutting current.

to the ventricle or false cord. In all borderline cases in which there is any doubt about the extent of the growth the entire larynx should be removed.

As a result of their experience Crowe and Broyles have evolved a one-stage operation for total laryngectomy which is simple, and free from shock and other postoperative complications. They adhere to the following rules:

1. The growth must be operable or intrinsic. The operation is not suitable when the cartilages are invaded, the false cord is involved, or the growth has spread to the muscles and glands of the neck.

2. The general physical condition must be such that the patient is a reasonably good operative risk.

3. Infection in the sinuses, tonsils, teeth, and gums must be eliminated before the operation.

4. The anesthesia should be a combination of avertin, procaine, and chloroform.

5. In the operative procedure, every effort should be made to avoid traumatization with clamps, retractors, or sutures. Bleeding is controlled with ligatures, instead of the high-frequency cautery. A closure is made that prevents leakage of mouth secretions into the wound or trachea. Pockets or dead spaces are avoided. The only drain left in the wound is a piece of rubber tissue, removed entirely on the third day after operation.

6. Fluids are given intravenously during the first twenty-four hours. On the third day after operation if there is no evidence of leakage or wound infection the feeding tube is removed and the patient is given a soft diet.

If the operation is properly done there is no loss of blood and no shock, and the patient usually sits up or gets out of bed on the second day. The incidence of postoperative complications, shock, pneumonia, cough, and a profuse mucopurulent tracheal discharge is in reversed proportion to the care with which the above rules are followed.

NOAH D. FABRICANT, M.D.

THE INTERVERTEBRAL DISC

A Critical and Collective Review

JOHN B. deC. M. SAUNDERS, M.B., F.R.C.S., and VERNE T. INMAN, M.D., Ph.D.,
San Francisco, California

INTRODUCTION

THE growth of an extensive and voluminous literature over the past several years testifies to the increasing recognition of the importance of the intervertebral discs. Thanks largely to the pioneer and careful work of Schmorl and his pupils at Dresden, impetus has been given to the study of the special pathology of these structures in correlation with the many clinical conditions affecting the spinal column. These newer observations are of interest not only to the orthopedic surgeon and radiologist, but also to the neurologist and general practitioner, and especially to those concerned with the problems of industrial medicine.

Herein is given a critical review of the literature, which presents the normal anatomy, physiology, pathological anatomy, and related clinical conditions as a more or less connected account.

Of the more extensive reviews covering the subject of the intervertebral disc, special mention should be made of the monographs of Beadle (22) in English, and of Mauric (203) in French. These works reflect the important influence of Schmorl who has gathered some 10,000 columns for study at Dresden. In addition, attention is directed to the monograph on the vertebral column in health and disease by Schmorl and Junghanns (288).

ANATOMY

Historically it is to Vesalius (311), in his correction of the observations of Galen, that we owe the first description of the main gross essentials of the discs. However, it is not until the publication of a monograph by Luschka in 1858 (182) that we find any detailed examination of these structures. With the growing recognition that the major part of spinal pathology involves the discs, much of it the outcome of degenerative phenomena, considerable study has been devoted to their normal anatomy, development, and physiological maintenance.

From the Division of Surgery and Department of Applied Anatomy, University of California Medical School, San Francisco, California.

It should be recognized that the discs comprise as much as one-fourth of the total length of the presacral portion of the spinal column. Varying in vertical thickness in different regions, they are thinnest from the third to the seventh thoracic vertebra and thickest in the lumbar segment. Inequalities in the thickness of their anterior and posterior aspects are in large measure responsible for the characteristic curves of the cervical, thoracic, and lumbar regions. In consequence pathological conditions involving the discs are frequently expressed in modifications of the normal curves. Jacobi (130), in a special study, gives details on the measurements of the discs at varying age periods.

To Schmorl, whose opinions receive special emphasis from Beadle, we owe the conception of the intervertebral disc as a complex functional unit consisting essentially of three parts: the annulus fibrosus, the nucleus pulposus, and the cartilage plates.

The cartilage plates cover the bony surfaces of the opposed vertebral bodies. Well defined in the central region, peripherally they disappear by blending into the fibers of the annulus. These plates should be regarded as an integral part of the disc, bounding it above and below in the manner of a drum-head. The relationship which the cartilage bears to the bone of the vertebral body is of importance. This aspect of the bone, known as the end plate ("Schlussplatte") of the vertebral body, is peculiar in that, in place of being compact, it presents centrally a number of fine perforations which correspond to intratrabecular intervals. It is through these perforations and the cartilage plate that the nutrition of the disc is largely maintained by diffusion (Schmorl, Beadle, Mauric), for the disc is an avascular structure. This is obviously a precarious mechanism and no doubt related to the early degenerative changes which so frequently occur in the discs. Brack (34, 35) has, however, described vessels in the outer part of the annulus. Schmorl (280) points out that Brack's observations were undoubtedly made on pathological discs, an opinion with which the reviewers would agree.

Confinement of the nucleus pulposus within the disc depends upon the integrity of these cartilage plates, and in this connection the junctional zone between annulus and cartilage plate on the dorsal aspect is of importance.

The annulus fibrosus or lamellosus consists essentially of concentric fibers passing in oblique and spiral arrangement from one vertebral body to the next. Regionally, this arrangement exhibits great variation (Labalt, 160; Rouvière, 254). The annulus receives firm attachment into the substance of the adjacent bone by means of the so-called fibers of Sharpey. Microscopically, the annulus is composed of fibrous and elastic lamellæ and irregularly scattered cartilage cells. Its firmest attachment to bone is anteriorly. The anterior longitudinal ligament, presenting well defined expansions at the level of the discs, blends with the annulus. On the other hand the posterior longitudinal ligament is a poor, ill-defined structure supporting the disc in the mid-line only and often displaying deficiencies where it is related to the disc.

The nucleus pulposus occupies approximately the center of the disc and is soft and elastic. The transition between annulus and nucleus is indefinite, the one blending into the other. In a young individual, the nucleus is semi-fluid and possesses a considerable elastic turgor. It consists of a loose network of fibrous strands with a variable number of cellular elements enmeshed. The cells are mostly fibroblasts and cartilage cells together with a few remnants of the notochord in the form of physaliferous cells of Virchow.

The existence of a rudimentary joint space, as contended by Luschka and Schmorl and contested by Beadle, is still a matter of doubt.

DEVELOPMENT AND MALFORMATION

The development of the spinal column has been closely studied for many years both from ontogenetic and phylogenetic aspects. For details on phylogeny the reader should consult the excellent though difficult monograph by Gadow (97). Briefly, in man the column arises by a condensation of mesoderm about the notochord which in the 4 mm. stage undergoes division into the segmental sclerotomes. The primitive, or protovertebræ show a tendency to split into cephalic and caudal halves. The caudal half fuses with the cephalic half of the succeeding segment to give rise to the anlage of the permanent vertebræ, the original segmental arrangement being changed for an intersegmental one. Chondrification proceeds in the intersegmental segments, and the mesoderm between the successive blocks of chondral tissue gives rise to the series of intervertebral discs, which are, therefore, segmental in origin. The nucleus pulposus is derived essentially from remnants of the notochord about which mucoid changes occur. With the ingrowth of vessels, ossification proceeds in the cartilaginous vertebræ, at first in the neural arches of both sides and slightly later in the vertebral centers. From these vessels fine capillaries pierce the cartilage plates and supply the disc. These vessels, however, undergo progressive regression and atrophy postnatally, and in adolescence are represented by scars only. Details of the arrangement are given by Boehmig (28) and Uebermuth (307, 308). Boehmig attaches great importance to these vessels and to the consequences of their regression. Faults not uncommonly found in the cartilage plates are ascribed to scars left by the obliteration of these minute vessels. In the opinion of these authors these defects are predisposing factors leading to fissuring of the plate and escape of nuclear material.

The notochordal canal is also of importance in the pathology of the disc. Although it is early transformed into a relatively cell-free ligament passing through the center of the vertebral body, it may persist and weaken the cartilage plate. (For further details on the primary centers of ossification and the fate of the chordal canal consult Boehmig.)

An important group of anomalies are those which have been interpreted as being due to the persistence of the chordal canal because of their possible relationship to the development of adolescent kyphosis. Persistence of the notochordal canal varies in degree. The more complete varieties are rare. Persistence of the canal over several segments is most common in the thoracic region and usually associated with evident malformation of the vertebræ and some degree of kyphosis. The "butterfly" vertebræ of Sereghi (294) no doubt fall into this group, although the reviewers have seen examples of extensive persistence of the chordal canal with but minor deformity of the vertebræ. Beadle describes several cases of canal persistence together with instances of dorsal and lateral displacement of embryonic chordal tissue. Minot (209) has traced in various animals the developmental displacements of notochordal tissue. One of the most common pathological findings in the adolescent spine is the presence of hemispherical nuclear expansions, particularly in the thoracic and lumbar regions. These expansions have been interpreted by Schmorl (275) as less incomplete closures of the chordal canal, which leave behind areas of congenital weakness and thinning

of the cartilage plates through which nuclear herniation into the vertebral spongiosa may occur.

Great attention has been paid by Schmorl and his pupils to the secondary epiphyses of the vertebral bodies because of their integral relationship to the disc and the production of adolescent kyphosis. In most vertebrates these epiphyses exist as bony plates covering the end surfaces of the centra. In man, however, they form simple rings of bone about the upper and lower surfaces of the periphery of the vertebral bodies. These epiphyseal centers appear in the cartilage and fill the furrows found radially disposed on the surfaces of the centra and extending over their outer edges. These several bony centers of ossification appear between the ages of eight and nine years in girls and at the age of thirteen in boys (Beadle); at from thirteen to fourteen years in girls and at fifteen years in boys (Mau, 197); at from eleven to twelve years (Buchman, 39); at from twelve to thirteen years (Edelstein, 80); at puberty (Cunningham, 65); at sixteen years (Gray, 111); and at from fourteen to fifteen years (Scheuermann, 265). At sixteen years or so they fuse and complete the epiphyseal ring, and between the ages of twenty and twenty-five years they usually unite with the bodies. Contrary to the generally accepted opinion, Schmorl (277) and Beadle regard this epiphysis as in no way analogous to a growth epiphysis. In their opinion it is purely a fixation organ through which the fibers of the annulus receive their attachment to the bone. Keyes and Compere (146) disagree with this view. From personal observations, we find little to support Schmorl's contention with regard to growth.

Malformation of the disc may be associated with a wide variety of congenital anomalies of the spine, such as anterior spina bifida, hemivertebræ, Klippel-Feil syndrome. Complete absence of the disc has been described in otherwise normal spines (Mauric). In such cases, which must be distinguished from those with the Klippel-Feil syndrome, the subjoined vertebræ are fused together. Schmorl and Junghanns point out that in the examples of what they term "Blockwirbel," the fused vertebræ equal in height 2 vertebræ together with the intervertebral disc, and that anatomical study of such specimens often reveals small remnants of the disc which cannot be detected in the roentgenogram. Care must be taken to rule out other conditions which result in vertebral synostosis.

PHYSIOLOGY

The rôle of the intervertebral disc in the absorption of shock and in the functional control and distribution of forces, such as pressure, tension, and torsion, has long been recognized. In addition, the disc permits of and is related to movements of the column. Robin (246), Fick (87), and Calvé and Galland (51, 54), among others, have demonstrated that the axis of movement of the column over a limited range passes through the nucleus pulposus. Virchow (313), Heuer (125), Bakke (14), and Wiles (315) have studied this question over more extensive ranges. They contend that in flexion the axis passes through the nucleus but that as full extension is approached the axis of movement shifts progressively dorsally. It is agreed that a certain amount of displacement of the nucleus is associated with movements of the column. In flexion there is dorsal displacement, in extension ventral displacement, and in lateral flexion displacement to the contralateral side; although variations in detail are recognized at the various levels. The extent of such displacements of the nucleus is as yet undefined but it would seem to be of importance in certain pathological conditions. For example, Galland (98) has discussed this matter in relationship to the pathology of congenital scoliosis and Mueller (220) in connection with the production of senile scoliosis.

Petter (235) by an ingenious method was able to measure the pressure of the nucleus pulposus in the fresh cadaver, which was found to average 30.2 lb. for each disc of the lumbar region. When the neural arches of the column are separated *en masse* from the bodies, the expansile force residing in the nuclei elongates the anterior segment while the tensile force of the ligaments of the arches shortens the posterior segment. The change approximates 10 per cent of the column (Saunders and Inman). De Puky (73) measured 1,200 individuals, between the ages of five and ninety years, and found daily oscillation in the total height. These oscillations amounted on the average to ½ in. in females and ¾ in. in males. The youngest individual showed the greatest daily change, and this value decreased steadily with increasing age. The total height was greatest in the morning and decreased during the day. These oscillations were attributed to changes in the turgor of the intervertebral discs, and the findings are of interest in relationship to the work of Uebermuth and Pueschel.

Uebermuth (307, 308), basing his observations on histological examination of the discs at various age periods, has attempted to trace the life history of the disc. He demonstrates the progressive changes in architecture due to the loss of fluid matrix as a result of which the disc loses elasticity

which is replaced by firmness. These changes are interpreted as functional adaptations to the demands of the various age periods. Pueschel (238) estimated the water content of both normal and degenerated discs. The content appears to be fairly constant in normal discs from the same individual. It is highest in the newborn (78 per cent annulus, 80 per cent nucleus) and decreases with age at first rapidly and then more slowly. The ratio of the water content of the annulus to the nucleus remains approximately the same until the fifth decade when rapid loss occurs in the nucleus. In degenerated discs the water content corresponds with the degree and type of degeneration. The recognition of a progressive desiccation is important in the interpretation of disc degeneration and in relationship to the maintenance of the spinal curves and the changes as seen in senile kyphosis.

DEGENERATION OF THE DISC

The intervertebral discs are subject to continuous and progressive changes of structure throughout life of such marked character as to make it difficult to determine what is normal and what is pathological. Degenerative phenomena are so frequent in supposedly healthy spines at middle age that the changes must be regarded as the outcome of age processes in an organ opposed to relatively violent forces of destruction as represented by functional activity (Beadle). The limits between the normal and the pathological for a particular age are difficult to define and causal factors in pathology are uncertain. Norlen (225) investigated the relationship between arteriosclerosis and disc degeneration and concluded that there was no constant evidence of correlation. Degeneration frequently sets in at an early age (third decade), which suggests predetermined factors. The life history of the disc as drawn by Uebermuth and Pueschel may be conveniently divided into two stages. The first, extending from fetal life to approximately the third decade, is characterized by an increasing turgor and elasticity of the nucleus, together with the crystallization of the fibers of the annulus in response to functional stress and strain. The second, from middle age on, is distinguished by progressive dehydration of the disc. The degree of degeneration in any one spine varies from disc to disc. The earliest changes are in the nature of a swelling of the nucleus and its encroachment on the annulus (Beadle) but with normal water values (Pueschel). The disc is, however, more fragile and has lost elasticity. In more advanced stages there is fibrillary degeneration with complete dissolution of the cells and fibers. The annulus is reduced to a peripheral ring and its fibers rupture. The change may be associated with the deposition of pigment, variable in extent, termed "brown degeneration" by Beadle. Necrosis, though less frequent, occurs in the anterior part of the annulus and calcification may occur (Schmorl). These small necrotic areas are often the starting point of fissures or tears of the annulus (Schmorl, and Janker 133), which are accompanied by hemorrhage when they extend through the cartilage plate into the spongiosa. Through such fissures, material may prolapse posteriorly and undergo metaplasia (Andrae, 9). Such posterior herniations will be discussed more fully because of their important clinical bearing. The cartilage plates may participate in the process of degeneration either by proliferation or by desiccation, or by the development of fissures and cracks with prolapse of the disc tissue into the spongiosa. Such prolapses must be distinguished from those which occur in earlier life and which will be considered under the heading of adolescent kyphosis.

LESIONS DUE TO TRAUMA

Whereas trauma is recognized as playing a most important rôle in bringing about the degenerative changes in the disc, only the more severe and violent injuries are discussed in this section.

Naturally, the disc is frequently involved in fractures of the vertebral bodies. Nevertheless, in compression fractures it is striking how much of the damage involves the bone and how little the adjacent discs (Beadle). Schmorl points out that injuries to the disc may take various forms. The cartilage plate may be fractured and lead to massive herniation of the nucleus into the spongiosa. The cartilage plates on the upper and lower surfaces of the body may be damaged, and material escaping from the adjacent discs fuses in the center of the body. These cases are important from the point of view of healing and too early weight bearing. The cartilage plate may be fissured with little damage to the spongiosa with the establishment of Schmorl's "Knorpelknoetchen." On the other hand, the spongiosa may collapse without damage to the cartilage plate which is followed by expansion of the nucleus and the formation of an amphicelous or fish-like vertebra, "Fischwirbelbildung." The annular part of the disc may be crushed in front or at the sides, with or without fracture of the bone. In these instances the centra may later undergo bony fusion with partial obliteration of the disc. An important group of cases to be discussed later are those in which the annulus is damaged posteriorly

with dorsal herniation of material into the spinal canal, as in the case of Middleton and Teacher (206). An interesting type of disc damage is that associated with marginal fracture of the body of the vertebra. The common anterior position in these fractures is readily appreciated when it is recalled that the annulus has its firmest attachment to the bone on this aspect. Although the chip fracture is insignificant, the fissure involves the cartilage plate and penetrates the disc with loss of its substance and eventual degeneration. This injury must be distinguished from the persistence of epiphyses (Hanson, 118, Janker, 133, Joisten, 134, Junghanns, 136, Michajlow and Tscherepnina, 205) and from epiphyseal damage (Schmorl). The radiological appearance of several of the above types of disc involvement is characteristic.

It is sufficient but to mention that the disc is involved in traumatic dislocation of the spine and undergoes degeneration thereafter. Minor injuries to the disc followed later by the development of small bony spicules in the margin of the disc are discussed by Mouchet and Nadal (218) and Mauric (203); and the question of diastasis is discussed by Hartmann and Monod (121), and Mauric (203).

INJURY TO THE DISC IN SPINAL PUNCTURE

It has been amply demonstrated that the nucleus pulposus, normally gelatinous in consistency, is confined under considerable pressure. Should the annulus be incised, even minutely, the compressed nuclear material is extruded and the disc undergoes degeneration. This has been shown to occur experimentally in dogs, monkeys, and rabbits (Keyes and Compere, 146, Tamman, 306, and Filippi, 88). Pease (232) was the first to recognize that similar extrusions followed by degeneration of the disc may occur in man after injury to the annulus by the spinal puncture needle. Billington (25) had, however, noted thinning of the disc and subsequent changes in the vertebral bodies following multiple spinal punctures in cases of cerebrospinal meningitis. The changes were attributed by this author to the inoculation of meningococci by the spinal needle. Pease demonstrated that a spinal-puncture needle, if correctly inclined and inadvertently inserted too far, would enter the disc, and that the loss of nuclear material which followed the injury could be observed in roentgenograms because of the narrowing of the intervertebral interval. Twelve such cases in which varying degrees of pain and disability resulted are reported by Pease. Milward and Grout (208) became interested in patients suffering from pain in the back and legs after surgical procedures in which spinal anesthesia was used. These authors report 5 cases which showed narrowing of the intervertebral interval opposite the level of insertion of a lumbar puncture needle. Localized arthritic changes confined to the injured segment rapidly developed. While believing the penetrating needle to be the initial cause of the changes observed, the authors think that a secondary inflammatory reaction weakens the fibrous wall of the disc and permits gradual escape of the nucleus. There is, however, ample experimental and other evidence to show that an injury of this type alone is sufficient to account for all the changes noted. Sicard (297) has reviewed this subject fully and points out that in lumbar puncture the disc is more liable to be injured when the spine is fully flexed.

HEALING OF THE DISCS AFTER INJURY

Several authors have investigated experimentally the problem of healing in the injured disc and the possible connection between injuries of the disc and the development of spondylosis deformans. Human material is naturally inadequate and very little is known on this subject. Experiments have been reported by Keyes and Compere (146), Lob (176), Schrader (290), Tamman (306), and Filippi (88). The animals employed were rabbits, dogs, and monkeys. Simple incision of the annulus was followed by immediate extrusion of the nuclear material. The healing of wounds in the annulus was uniformly poor and imperfect, and in many instances the gaps persisted for several months. The nuclear material completely disappeared and was replaced by loose connective tissue. This was followed by proliferation of the cartilage of the end plates. In the majority of instances the disc collapsed and the intervertebral space was diminished with limitation of motion. In the animals allowed to survive for six months or longer, the end surfaces showed sclerosis with lipping and bony spur formation. According to Tamman's observations such osteophyte formation was more prone to occur when the disc had been crushed. Keyes and Compere conducted a series of experiments in which the cartilage plate was injured by a drill passed obliquely through the bodies of the vertebræ into the nucleus without damage to the annulus. Nuclear material prolapsed into the spongiosa and was replaced by cartilage which formed nodules similar to Schmorl's "Knorpelknoetchen." Thinning of the disc with lipping and spur formation occurred in the animals allowed to survive for some period of time.

LESIONS DUE TO DISEASE

The discs seldom appear to be involved, either primarily or secondarily, in disease processes, whether they be infectious or neoplastic (Schmorl), with the exception of advanced tuberculosis (Beadle). The cartilage plates are extraordinarily resistant to invasion, although in youth vessels in the plates form possible channels of infection (Beadle). In acute staphylococcal osteomyelitis, invasion of the disc is relatively frequent (Mauric), although only in the more destructive processes (Beadle). In the spondylitis of typhoid and influenza the discs are not involved. As the lesion is often subepiphyseal in tuberculosis the discs may be involved early; however, they may escape for some time (Sorrel and Sorrel-Déjerine, 302). The discs may be involved in syphilitic spondylitis (Darier, 68) and in the late stages of a syphilitic osteoarthropathy (Pape, 231), as well as in syringomyelia (Cornil and Francfort, 62, 63). In osteoporotic conditions of the spine the discs are unaffected and do not undergo degeneration (Norlen, 225), but as the discs are unsupported they expand and give rise to fish-like vertebræ. The cartilage plate may rupture from the tension with the escape of nuclear material. Benign tumors of the spine do not involve the discs, and the latter seem even more resistant to malignant disease than to infection (Beadle).

CALCIFICATION OF THE DISC—CALCINOSIS INTERVERTEBRALIS

Calcification of the disc has been recognized as occurring in two different sites: namely, the nucleus and the annulus. Each type exhibits significant pathological and clinical differences.

Attention was first called to the possible clinical importance of calcification of the nucleus by Calvé and Galland (49), and numerous examples have been subsequently reported. As early as 1858 calcification has been observed (Luschka 182, Beneke 24). Barsony and Polgar (21) point out that the deposits are usually restricted to the center of the nucleus but may spread to involve the entire nucleus. Radiologically such deposits, even when extensive, show a clear area about their periphery, which has been termed the calcium resisting zone (Kalkresistentere Zone). This zone segregates the calcified area from the annulus (Barsony and Koppenstein, 20).

The deposits occur typically in the lower thoracic region of patients more than thirty years of age, and the maximum incidence appears to be at the tenth thoracic disc. Usually a single or adjacent discs are involved, seldom more. Cases have been reported in children in which the cervical as well as the thoracic discs were affected (Baron, 15, Kohlmann, 153, Hoffmann, 127, and Lyon, 186, 188, 190).

The few deposits which have been observed post mortem have proved to be amorphous. The disc may be well preserved or may show brown degeneration or other forms of atrophy (Beadle). Chemically, the deposits consist of carbonate and phosphates of lime (Calvé and Galland, 53). Schmorl has recovered uric acid from some of them. They have been found devoid of structure, occupying a pseudocavity in the disc. They are no doubt analogous to the calcium deposits found elsewhere in and about joints (Hitchcock, 126), the essential mechanism of which has been admirably demonstrated by Klotz (149). This author has shown that the deposition of calcium is always preceded or accompanied by the formation of soaps in the degenerating tissue, to which calcium is immediately attracted from the body fluids. Such soaps may be found in the peripheral zone of calcareous infiltration while calcium is still being laid down. Replacement of the fatty acid by the stronger phosphoric and carbonic acids ensues, and gives rise to the more stable calcium phosphates and carbonates of which these deposits are largely comprised.

Since the initial observation of Calvé and Galland, the clinical significance of such deposits is still debatable, although the greater proportion of authors claim a definite syndrome. It would appear from the literature that the observations fall into three definite groups:

1. In children the deposits are accompanied by severe local symptoms of backache, muscle spasm, and restriction of motion. Constitutionally there is moderate fever and malaise resembling influenza [Baron, Kohlmann, Klar (148), Hoffmann, Lyon], and in Baron's case there was an accompanying leucocytosis of 12,000. Following clinical improvement, often delayed for months, there is gradual absorption of the deposits.

2. In patients over thirty years of age, many authors associate the presence of deposits with symptoms of backache, muscle spasm, and pain which shows a tendency to radiate over the correspondingly affected segments. The radiation is ascribed to pressure on nerve roots by the swelling of the discs. How this occurs is difficult to understand. The radiation of pain unrelieved by rest, support, or position is regarded, chiefly by French authors, as characteristic (Roederer, 249, 250, *et al*).

3. There are cases in which the finding of such deposits is purely incidental and unaccompanied by any definite subjective or objective signs re-

lated to the area involved. The reviewers have encountered a number of cases in which the deposits were associated with evidence of degenerative changes at other levels.

As is well known, calcification or ossification is more frequent in the annulus than in the nucleus, the incidence increasing with age. Central calcifications are limited to the region from the fifth thoracic to the first lumbar vertebra, whereas annular calcifications occur throughout the column (Barsony and Koppenstein, 20). Rathcke (242) investigated 200 columns and found calcium deposits in both the annulus and the nucleus in the ratio of 71 to 6.5. In individuals less than twenty-nine years old none was discovered in the nucleus, but 28.5 per cent of the specimens examined showed calcium deposits in the annulus. The deposits exist as either amorphous masses of calcium salt or organized bone. When present as the calcium salt they are usually small and often multiple, readily lifted out from the surrounding tissue. When present as bone they are much larger and may attain a considerable size with the formation of a definite spongiosa. Niedner (224) found true bone formation, most frequently in the cervical and lumbar spine, in 2 per cent of a series of 400 columns. Schmorl has called these deposits "Schaltknochen" and distinguishes them from osteophytes as they are imbedded in the annulus and have no connection with the vertebral body. They are nearly always found in older spines associated with true osteophyte formation. Niedner agrees with Schmorl that they are the result of degeneration. Bufnoir and Legras (43) point out that they are found only in the anterior part of the annulus. Schmorl and his pupils attach no particular significance to these deposits except as evidence of disc degeneration. On the other hand, Mauric believes that they result from the same causes (infection and trauma) and have the same pathology as ossification of the nucleus. Furthermore, he believes that they cause pain and produce spinal deformity when they involve the anterior longitudinal ligament.

In the reviewers' opinion calcification of both the nucleus and annulus is in the majority of instances without clinical significance except as evidence of degeneration, but in younger individuals it may be related to trauma, a distinction, however, which is difficult to make.

THE DISC AND SPINAL DEFORMITY

It is evident that alterations in the disc influence considerably the spinal column as a whole; this influence is expressed especially by changes of curvature. Newer concepts of the physiological rôle and life history of the disc have, therefore, led to clearer ideas of the genesis and classification of spinal deformity. Although there is still much that is contentious and many types overlap, these contributions constitute a major advance in an otherwise confused field, and any general view of the intervertebral disc necessitates a brief consideration of this effort.

ADOLESCENT KYPHOSIS

This deformity is a well defined condition appearing in adolescents from about the twelfth year on and if not due to primary involvement of the disc, degeneration of the disc is a marked secondary feature. Clinically, adolescent kyphosis is characterized by the development of a rigid, smooth kyphosis with roentgenologically demonstrable changes in the bodies of the vertebræ. These changes consist of irregularities of the margin of the bone opposite the discs which are invariably narrowed. The vertebral bodies assume sooner or later a more or less cuneiform shape. In addition to the kyphosis there is sometimes a slight scoliosis. The dorsal column is most frequently affected, although a corresponding condition in the lumbar spine is described (Eckhardt, 79, and Lindemann, 174), which the reviewers believe is not nearly as infrequent as is thought. French authors stress the presence of pain (Sorrel and Delahaye, 304), which is not a universal symptom and is more often in the nature of an ache on exertion. Attention has been drawn to a greater incidence in boys (Scheuermann, 265, Mau, 199, Boerema, 26, Edelstein, 80), an incidence which is probably more apparent than real; and this opinion is shared by Schildbach (269). The condition shows varying degrees of progression, and, with early recognition, the deformity may be minimized by immobilization. Correction of the fully developed deformity has been attempted but in the general experience has proved unsatisfactory. Late symptoms of back strain, the mechanical result of a rigid segment of the spine, are common.

The etiology of the condition is still obscure. First described by Schanz (260, 261) and again by his pupil Elsner (86), it was related to the effects of heavy work on the growing spine and the terms "apprentice kyphosis" (Lehrlings Kyphose), or "occupational kyphosis," were introduced. The importance of mechanical strain has been especially stressed by German writers. This aspect seems to have been overstated in view of the large number of cases which occur among individuals who have not been subjected to arduous occupations. Lambrinudi (161) re-

gards shortness of the hamstrings, by no means always observed, as of prime importance in leading to fracture of the cartilage plates of the disc. Schanz's view has been interpreted, though incorrectly according to Eichelbaum (81), as suggesting muscular insufficiency to be the primary cause, and the term "muscular" kyphosis has been employed.

General recognition of the condition, far more common than supposed, is the outcome of the work of Scheuermann (265, 266, 267, 268) who regarded the condition as an epiphysitis analogous to Legg-Perthe's disease and who termed it "osteochondritis deformans juvenilis dorsi" (Scheuermann's disease).

Schmorl (275, 282, 285) has brought forward strong evidence which would show that the kyphosis is the direct result of alterations in the intervertebral discs, a view which has received considerable support (Calvé, Galland, Beadle, *et al*). He has demonstrated by post-mortem evidence that prolapse of the nucleus pulposus into the spongiosa of the vertebral bodies may occur, even in children, as the result of congenital weakness or defect of the cartilage plates. Disturbances of the cushioning effect of the nucleus in overloading and trauma lead to secondary changes in the epiphyses and bodies of the vertebræ. Radiologically, the presence of such hernias cannot always be discovered, which is explained as being due to the absence of reactive changes in the bone, for it is not the prolapse but the bone sclerosis about the prolapse which renders Schmorl's "Knorpelknoetchen" visible. It is true that in many cases these notches become evident only in the later stages of the disease. Schmorl's theory has not been without criticism even by its supporters.

Among other causes suggested have been endocrinal disturbances, nutritional factors, infection, and vascular changes from trauma.

It would seem from the reviewers' experience that all cases do not fall into the same category. Whereas Schmorl's theory offers a satisfactory explanation in some instances, the relationship to sudden spurts of growth has not been considered. In the majority of cases the disc is profoundly affected and many of the changes in the spine are without doubt related to the early degeneration which secondarily affects the discs.

SENILE KYPHOSIS

Senile kyphosis has been recognized for many years and grouped in a somewhat confused manner with the deforming conditions of old age. Schmorl, recognizing the primary changes as a special type of disc destruction, has segregated senile kyphosis as a distinct condition. Knaggs (150) had previously drawn up a classification of these deformities in which he specified a type characterized by an upper dorsal curve and atrophy of the intervertebral disc. He called attention to trauma and heredity as predisposing factors and noted that the morbid changes involved more particularly the anterior part of the disc. This type agrees well with Schmorl's "Alterkyphose." Knaggs subdivided this type into spondylitis muscularis and senilis. Beadle, however, in discussing Knaggs' classification, cannot agree that it is possible to separate a form not included under spondylitis senilis, as the disease is one complex developing earlier or later in life.

The characteristic feature of senile kyphosis is the curvature which appears usually late in life and develops rapidly as an exaggeration of the physiological thoracic curve (Alajouanine and Mauric, 4), but differs from the kyphosis of adolescents in that it exists pre-eminently in the upper or middle thoracic region (Beadle). The cartilage plates are intact and the discs well preserved in the greater part of their extent without the various degenerative changes of senility. The characteristic pathological feature is necrosis of the anterior part of the disc. Concentric tears with hemorrhage often follow (Schmorl, 281, 286, 288). Eventually the neighboring vertebral bodies come in contact anteriorly, separated by a small amount of disc which shows fibrous infiltration or undergoes ossification. The remainder of the disc, otherwise well preserved, gives the appearance of being incomplete anteriorly in a number of segments, and in these positions the spine is ankylosed. The vertebral bodies become cuneiform in shape, although not as markedly as in adolescent kyphosis. Those cases which show extrinsic disc degeneration and osteophyte formation are considered as impure types exhibiting a coexistent spondylosis deformans (Beadle).

SPONDYLOSIS DEFORMANS (SPONDYLITIS OSTEOARTHRITICA)

A clear separation into two types of the so-called rheumatic diseases of the spine, on the basis of etiology, pathology, and clinical manifestations, is now well established. In the first, spondylitis ankylopoietica (Bechterew-Marie-Strumpell) or rheumatoid arthritis of the spine (Miller, 207), the lesion is recognized, except by Krebs (158), as being primary in the small intervertebral joints (Fraenkel 94, Elliott 82, *et al*), followed by a smooth ossification of the anterior longitudinal ligament without osteophyte formation. The disease is regarded as infective in origin

although non-specific. The clinical findings are suggestive of such origin, and, unlike osteoarthritis, the sedimentation rate is markedly increased, as in infectious arthritis. Recent work would indicate, however, some association with Vitamin-C deficiency (Rinehart, 245). In ankylosing spondylitis the discs disappear to a greater or less extent and are replaced by bone.

In the second group, spondylitis osteoarthritica, the important conception that the condition is primarily the outcome of disc degeneration is steadily gaining ground. Toxic factors are relegated to a secondary position which may serve but to accelerate the process. For this reason the term "spondylosis" is considered preferable to "spondylitis" which suggests an inflammatory origin (Schmorl, Beadle).

Lane (166) considered that the pathological condition hitherto described as rheumatoid arthritis of the spine and related joints was not due to any disease but was the outcome of occupational trauma. Beneke (24) stressed degeneration of the disc as the exciting cause and contributed interesting observations on the effect of functional stress by reference to the position of osteophyte formation. He pointed out that lipping predominated on the right side in the thoracic regions and on the left side in the lumbar regions of right-handed individuals, while the reverse arrangement occurred in left-handed individuals. Of the classical studies, mention should be made of the careful anatomical and roentgenological investigations on osteoarthritis and ankylosing spondylitis by Simmonds (298) and Fraenkel (94).

Little was added to these morphological descriptions until the work of Schmorl and his pupils. Rokitansky (251) had commented upon the loss of resiliency in the disc with advancing age and Luschka (183) observed some of the changes of senility. However, it was only with the contributions of Uebermuth (307, 308), Boehmig (28), Pueschel (238), and Beadle (22) of Schmorl's group, that a clear picture of the life history and physiological maintenance of the disc was established. Other studies are those of Norlen (225) on 309 subjects between the ages of eighteen and eighty-nine, and of Smith (300) on 57 spines from persons from one to eighty-six years of age. Schmorl from his unique collection of some 10,000 spines examined 4,253 for osteophyte formation. The group was composed of almost equal numbers of male and female subjects. The age incidence was about the same in both sexes with a tendency for the condition to be more advanced in males. This incidence is at variance with that of others who report a greater incidence in males. As is well recognized, osteophyte formation showed a definite relation to age, and it is significant to note an onset as early as the third decade. From the third to the tenth decade in males, the percentage with spondylosis deformans was respectively 10.7, 36.3, 77.8, 93.2, 97.3, 98.4, and 100.0. Spondylosis deformans is viewed as the outcome of a progressive series of events. The discs, through age or individual predisposition, lose elasticity and under the influence of continuous functional trauma pass through the various stages of degeneration: fibrillary degeneration, brown degeneration, cartilage-plate rupture, nuclear prolapse, necrosis, fissuring, hemorrhage, vascularization, and reactive changes. Loss of turgor permits of increased mobility between the segments with strain of the ligamentous structures, loss of the cushioning effect, and an increased liability to spinal damage. These effects are followed by osteophyte formation which may proceed to ankylosis. Non-appearance of osteophytes posteriorly is accounted for by the less close relationship of the posterior longitudinal ligament to the vertebral bodies (Beadle). The osteophytes occur in and follow the course of the spinal ligaments (Beneke, Beadle, Weil, and Lalanne 314, Gottlieb 110). The experiments of Keyes and Compere (146), and Tamman (306) on animals lend strong support to the view enunciated by Schmorl on the genesis of spondylosis deformans.

The fact that degeneration is often early in onset and does not affect all segments equally emphasizes the importance of complete examination of the column in the assessment of spinal disabilities. In addition, consideration of the views expressed by Schmorl point the way in this common lesion, to a more rational therapeusis.

POSTERIOR HERNIATIONS OF THE NUCLEUS PULPOSUS

The significance of posterior herniation of the nucleus pulposus in causing pressure on the contents of the neural canal has of recent years become increasingly appreciated. The evolution of our knowledge of this subject extends over a full quarter of a century. Middleton and Teacher (206) were the first to call attention to the possibility of nerve compression by herniation of nuclear material. Their patient, while lifting a heavy object, heard a "crack" in his back and suffered severe pain in the lumbar region which was followed by a paraplegia. Sixteen days later the patient died and at autopsy, hemorrhage and softening of the lumbar enlargement were found to be due to a herniated mass of pulp from the intervertebral disc between T12 and L1. Impressed

with trauma as a factor in the displacement, the authors carried out experimental observations on cadavers. By pressure with a vice they were able to force nuclear material through the inner layers of the annulus. This was accompanied by bulging of the disc close beside the posterior longitudinal ligament. They were satisfied that trauma could displace the nucleus in the direction which it must have followed in the victim of the accident. An extensive search of the literature of the time disclosed only one other case of traumatic rupture of the disc, although Virchow (312) had mentioned such a finding. Kocher (151) found the disc between L1 and 2 completely smashed in a patient who had fallen on his feet from a hundred feet. The bodies of the vertebræ were intact but no information on the direction in which the crushed portions of the disc travelled was given. Goldthwaite (109) reported the unfortunate experience of the development of paraplegia in a patient manipulated for low back pain. The possibilities of dislocation of the fifth lumbar vertebra and of dorsal protrusion of the disc were considered, but no definite conclusion was reached.

For many years surgeons had recognized that extradural cartilaginous or pseudocartilaginous tumors were not infrequently encountered, notably in the lumbar region. Elsberg (83) mentions chondromas, fibromas, and exostoses among extradural tumors. In a subsequent paper (84) he states that chondromas comprise 24 per cent of all extradural tumors and, although recognizing their origin as from the intervertebral disc, he regards them as new growths. Moons, Van Bogert, and Nyssen (216) report a definite syndrome from pressure on the cauda equina by chondrochordomas. Stookey (305) published a study on cervical extradural chondromas. Alajouanine and Petit-Dutaillis (5) described a case of cauda-equina compression in which what is called a fibroma of the intervertebral disc was removed by laminectomy. Robineaux (1929) operated upon 2 cases of tumor, one described as a fibrochondroma arising from the disc and the other as an osteofibrochondroma with a preponderance of fibrous tissue. Veraguth (310) removed a partially necrotic cartilaginous tumor from the fifth lumbar disc. Krabbe (156) discusses the autopsy findings in a patient who suffered over a period of fifteen years from symptoms of progressive cauda-equina compression. A partly ossified, massive prolongation of the fourth lumbar disc was disclosed. Bucy (42), and Bailey and Bucy (13) discuss a case of sciatica which developed after the patient lifted a heavy object, and in which they found at operation a fibrocartilaginous nodule. Elsberg (85) devotes a lengthy article to the subject of extradural chondromas. He concludes that they are not at all infrequent, constituting 36 per cent of all extradural growths, and that the favorite sites are the lumbar and cervical intervertebral cartilages. In Elsberg's view they cannot be strictly regarded as neoplasms for their growth is limited. Appearing to be local hyperplasias, they must be classified from the histological standpoint as ecchondroses. The dividing line between neoplasm and ecchondrosis, he says, is hard to fix, but the term chondroma may be sanctioned. Alpers, Grant, and Yaskin (8) review 35 cases of such tumors from the literature, to which they add 1 case of their own. They found that 46 per cent of the tumors occurred in the cervical, 37 per cent in the lumbar, and 17 per cent in the thoracic region. Discussing the pathology they recognize that these tumors, consisting predominantly of newly formed connective tissue, must arise from the intervertebral disc, but they are not sure that they are neoplastic. In about half of these cases there was a definite history of trauma followed by symptoms of spinal-cord tumor or compression of a nerve root.

A new phase begins with the report by Dandy (67) of 2 cases presenting symptoms simulating spinal-cord tumor, in which he found loose cartilaginous bodies derived from the intervertebral discs. The lesions, he says, were undoubtedly of traumatic origin and the masses resembled the bodies found in osteochondritis dissecans. The bodies presented to one side of the midline and were accompanied by swelling and foreign-body reaction. He fails to relate them in any way to cases previously reported as ventral extradural chondromas.

Pathologically, posterior herniations of the nucleus pulposus have been recognized by Schmorl (273, 276), Andrae (9), and their coworkers as the outcome of disc degeneration. These authors, while recognizing that such protrusions might produce pressure on the contents of the neural canal, considered this improbable in view of the fact that they were usually small and flattened and occurred beneath the posterior longitudinal ligament. Andrae investigated 368 columns and found posterior cartilaginous nodules (Schmorl's Knorpelknoetchen) related to the discs in 56 or 15 per cent. In about half the cases more than one nodule was found at the same level. The greatest incidence was in the lower thoracic and upper lumbar regions and, next, in the lower lumbar region, although none was found in conjunction with the fifth lumbar disc. They occurred occasionally in the lower cervical spine. Initially, Schmorl regarded these

bodies as accessory nuclei pulposi or chordal "rests." Luschka (182) had regarded them as chordomas, an opinion with which Virchow disagreed because of the absence of physaliferous cells. In a subsequent paper Schmorl (273) agrees with Andrae that these structures have origin as herniations or protrusions of the nucleus pulposus of the intervertebral disc. In almost all cases in which such nodules were found, the disc showed evidence of "brown" degeneration, but the defect through which the nuclear material extruded was not always apparent. In 1 case, a definite rent in the annulus through which nuclear material had passed could be demonstrated. These authors concluded that the herniated material underwent metaplasia into cartilage or fibrocartilage, which may show calcification or even new bone formation. Such herniations were never found other than posteriorly, and in Schmorl's opinion the location of the nucleus pulposus, further removed from the front and sides but closer to the back of the disc, makes their position intelligible.

Galland (98, 99) discussed dislocations of the intervertebral disc in general and the association of retropulsion of the nucleus with paraplegias in particular. Kortzeborn (155) pointed out that the "Knorpelknoetchen" of Schmorl could cause symptoms by pressure on the contents of the neural canal. He described a case diagnosed pre-operatively as spinal-cord tumor. On laminectomy, later found to be too high, there were no definite pathological findings. At subsequent autopsy, however, a nodule on the posterior surface of the disc between C6 and 7 was discovered as being responsible for the pressure symptoms. Crouzon, Petit-Dutaillis, and Christophe (64) reported a case of cauda-equina compression following trauma due to the presence of a fibrocartilaginous nodule arising from the disc. Mixter and Barr (212) reported operations in 19 cases of herniations or, as they prefer to call it, rupture of the intervertebral disc into the spinal canal with symptoms of spinal-cord tumor. This lesion, they contend, has frequently been mistaken for cartilaginous neoplasm, but in their series rupture is more common than neoplasm, in the ratio of 3 to 1. In addition they point out the importance of recognition of this lesion in orthopedic cases presenting symptoms of low back pain and sciatica which fail to respond to ordinary treatment, and that in cases of presumptive spinal-cord tumor this lesion must always be sought. Peet and Echols (233) reported 2 cases with symptoms of spinal-cord tumor in which, after operation, the tumors were found to be composed of nucleus-pulposus tissue which had undergone secondary changes after herniation. Mixter and Ayre (211) described a series of 15 cases of nuclear herniations. They accept the view that ecchondromas, Schmorl's nodules, and the herniated masses are identical, but report that in the view of their neuropathologist, Kubik, both nucleus and annulus are represented in most specimens removed. They believe that the term herniation or rupture of the disc is more descriptive than prolapse of the nucleus pulposus, as used by Schmorl.

With the clearer recognition of the true nature of this lesion, together with the finding that such herniations are the major cause of sciatica, case reports and studies have appeared in increasing numbers in the literature of all countries. The following are some who have made such contributions: Mauric (203), Hampton and Robinson (117), Love (177), Schachtschneider (259), Busch and Christensen (44), Hawk (122), Olin (227), Sherwood and Berens (296), Slaughter (299), Love (178), Love and Camp (180), Barr (17), Barr, Hampton, and Mixter (19), Brown (38), Schulze (292), Chiasserini (58), Kagan (145), Lenshoek (169), Mixter (210), Paltrinieri (230), Rubino (257), Jaeger (131), Glorieux (108), Hadley (113), Camp (56), Naffziger, Inman, and Saunders (222), Love and Walsh, (181), Money (214), Fincher and Walker (89), Schapira (264), Shelden, Carmichael, and Adson (295), Barr (18), Poppen (237), and Furlow (96).

Most authors agree that in the majority of instances the protrusion is the outcome of trauma, occasionally single and severe, more often repeated or rather indefinite, such as following falls, bending, lifting, or torsion. In a minority no history of trauma can be elicited. It is acknowledged that the lesion occurs most frequently in the lumbar region, notably in the third, fourth, and fifth discs, less frequently in the lower cervical, and least frequently in the thoracic discs. There can be little doubt that an apparently normal disc may be ruptured in a few instances, but a great deal is to be said for the view that the rupture occurs from the effects of trauma acting upon a disc already weakened by degeneration. This is indicated by the fact that the majority of cases occur in patients in the fourth and fifth decades when, as Schmorl has shown, degenerative phenomena are common; and it is surprising how often a more extensive radiological examination of the spine reveals evidence of degeneration at other levels. It is suggested that in cases of medicolegal importance such a complete examination be made for assessment of the injury. The

somewhat greater incidence in males emphasizes the mechanical factor.

For an understanding of the precise mechanism of root pressure and for the exact interpretation of radiological findings, an appreciation of the anatomy of the region is essential. Two studies are devoted to this aspect. Hampton and Robinson (117) investigated the anatomical basis of the normal lipiodol picture and its relationship to rupture of the disc. Naffziger, Inman, and Saunders (222) discuss the detailed anatomy of the region, anatomical factors bearing on the lesions and mechanisms involved. These studies are restricted to the lumbar region. More extensive lesions with symptoms of cord tumor or cauda-equina pressure are easily recognized, but lesions of the lumbar region which often involve but a single root and produce symptoms readily confused with disorders of the sacro-iliac joint, low back strain, sciatica, and the like are more frequent. The key to diagnosis rests with consideration of the anatomical arrangement and careful radiological methods.

Robinson and Hampton emphasize that after the injection of lipiodol, the lumbar subarachnoid space normally fills symmetrically. In anteroposterior roentgenograms a series of small, triangular shadows are seen on either side of the opaque column. These shadows are produced by the filling of out-pocketings of the arachnoid space along the inferior aspect of the emerging spinal nerve. The nerve itself occupies the clear area between the curved shadow of the root of the pedicle, lateral and above, and the triangular shadow of lipiodol, below and medial. The disc lies opposite the upper end of the base of these triangles. Herniations occur at the level of the disc and in consequence deform the dural sac at these levels. Contrary to expectation, the lateral view often gives surprisingly little information. As a rule the diagnosis is not difficult when the defect is large or the canal is completely blocked. In all cases observation of the movement of the oil is essential to locate the defect. In difficult cases knowledge of the normal appearance of filling is a great asset in interpretation.

Reactions following the use of lipiodol in the subarachnoid spaces are discussed by Globus and Strauss (107), Odin, Runström, and Lindblom (226), Lindblom (173), Harkins (120), Hagueneau (115), and Hampton and Robinson (117). Hampton and Robinson point out that those who use the oil most frequently cite the fewest reactions. However, the possibility of such reactions and the difficulty of completely removing the oil at operation has induced many to employ amounts as small as 2 c.cm. for diagnosis. Such small amounts are insufficient to outline the subarachnoid space and make diagnosis more difficult. For adequate filling 5 c.cm. would seem to be the optimum amount.

The attempt to obviate the potential risks has lead some clinics to use air, as suggested by Dandy (66), for visualization of the ventricles. Coggeshall and von Storch (60) claim to be the first to introduce air myelography. Van Wagenen (309) reported 3 cases of complete spinal block demonstrated by air. Young and Scott (321) give precise directions as to the use of air and report 13 cases, 5 of which were herniations of the nucleus, diagnosed by this method. Stereoscopic pictures are essential for delineation of the sac. These authors conclude that air myelography presents by its transparency certain advantages and is the method of choice. The use of lipiodol, in their opinion, is justifiable only when air studies are negative and there is good clinical evidence of a space-taking lesion of the spinal canal. None the less, air myelography has not as yet found universal acceptance because of difficulties in interpretation.

SYMPTOMS AND SIGNS

The symptoms naturally depend entirely upon the location and size of the herniation (Mixter and Barr, 212), and many herniations must be asymptomatic as shown by their frequency in postmortem findings (Schmorl, 273, 276, and Andrae, 9). The majority of authors have noted that the symptoms are frequently curiously intermittent: in 84 of 100 cases reported by Love and Walsh (181). This is due perhaps to a congestive as well as a mechanical factor (Glorieux 108). Schachtschneider (259) observed in fresh cadavers partial return of the herniated nucleus in flexion and protrusion with extension, findings which were confirmed by Glorieux (108), and Love and Walsh (181). The duration of the symptoms is extremely variable, from months to years, but usually much shorter in the cervical than in the lumbar region. At cervical and thoracic levels the symptoms and signs are those of extradural tumors. In the lumbar region, the most common symptom is intractable sciatica with or without backache, usually both (Mixter and Barr, 212, Jaeger, 131, Love and Camp, 180, Naffziger, Inman, and Saunders, 222, and Love and Walsh, 181). The pain may be aggravated by straining, sneezing, or coughing, although not consistently, and frequently it can be induced by jugular compression. Straight leg raising usually gives severe pain. Hypesthesias, anesthesias, and muscle weakness usually appear

together (Jaeger 131). Absence or diminution of the Achilles reflex is important (Naffziger, Inman, and Saunders), but it was observed only in 57 per cent of Love and Walsh's cases. A lumbar list toward or away from the side of the lesion may be present. Sphincteric incontinence is uncommon. The sensory, motor, and reflex changes are usually too indefinite to permit localization of the lesion by physical examination alone. In a considerable proportion of cases the spinal fluid shows an increased total protein content although the absence of an increase does not exclude the diagnosis.

The final diagnosis rests with the introduction of lipiodol into the canal and radiological examination.

TREATMENT

Treatment is removal of the protrusion by laminectomy which, with exact localization, can be limited in extent. At times the mass may be difficult to find, especially if it extends laterally into the adjacent foramen. The possibility of injury and hypertrophy of the ligamentum flavum producing identical symptoms must be kept in mind. (For injuries of the ligamentum flavum see Brown (38), Naffziger, Inman, and Saunders).

Fixation of the spine by graft is usually not considered necessary but this matter is still *sub judice.*

LATE RESULTS

By and large the postoperative results have been good, but it is too early to assess these at this juncture. An odd case of the later development of a false meningocele with herniation of the nerve roots has come to our notice. This was the outcome of the use of interrupted sutures in the dural sac, and therefore continuous suture of this structure is advised.

BIBLIOGRAPHY

1. Abadie, J. Les ostéo-arthropathies vertébrales dans le tabès. Paris: Masson, 1900.
2. Adson, A. W. Northwest Med., 1925, 24: 309.
3. Afenassjev, M. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1929, 40: 140.
4. Alajouanine, T., and Mauric, G. Presse méd., Par., 1933, 41: 1269.
5. Alajouanine, T., and Petit-Dutaillis, D. Bull. et mém. Soc. nat. de chir., 1928, 54: 1452.
6. Idem. Presse méd., Par., 1930, 38: 1749.
7. Ibid., p. 1657.
8. Alpers, B. J., Grant, F. C., and Yaskin, J. C. Ann. Surg., 1933, 97: 10.
9. Andrae, R. Beitr. z. path. Anat. u. z. allg. Path., 1929, 82: 464.
10. Arlabosse. Bull. et mém. Soc. de radiol. méd. de France, 1931, 19: 402.
11. Ayres, C. E. New England J. Med., 1935, 213: 716.
12. Bachmann, A. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1930, 42: 500.
13. Bailey, P., and Bucy, P. C. Surg. Clin. North Am., 1930, 10: 254.
14. Bakke, S. N. Acta radiol., 1931, Supp. 13, p. 71.
15. Baron, A. Jahrb. f. Kinderh., 1924, 104: 357.
16. Baron, A., and Barsony, T. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1927, 36: 377.
17. Barr, J. S. J. Bone & Joint Surg., 1937, 19: 323.
18. Idem. Surgery, 1938, 4: 1.
19. Barr, J. S., Hampton, and Mixter. J. Am. M. Ass., 1937, 109: 1265.
20. Barsony, T., and Koppenstein, E. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1930, 41: 211.
21. Barsony, T., and Polgar, F. Klin. Wchnschr., 1925, 4: 759.
22. Beadle, O. A. The Intervertebral Discs. London: H. M. Stationery Office, 1931.
23. Belugou, C. Contribution à l'étude de la calcification des disques intervertébraux. Thèse de Paris, 1932. Imprimerie Tégui.
24. Beneke, R. Beitr. z. wissensch. Med. Festschr. . . . d. Versamml. deutsch. Naturf. u. Aerzte. . . . . , 1897, 69: 109.
25. Billington, R. W. J. Am. M. Ass., 1924, 83: 683.
26. Boerema, I. Arch. f. klin. Chir., 1931, 166: 737.
27. Boehmig, R. Muenchen. med. Wchnschr., 1929, 76: 1318.
28. Idem. Arch. f. klin. Chir., 1930, 158: 374, 424.
29. Idem. Arch. f. path. Anat., 1931, 280: 873.
30. Boehmig, R., and Prevot, R. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1931, 43: 541.
31. Bohne, O. Ztschr. f. orthop. Chir., 1929, 50: 764.
32. Boorstein, S. W. J. Bone & Joint Surg., 1927, 9: 629.
33. Botreau-Roussel and Huard. Ann. d'anat. path., 1930, 7: 782.
34. Brack, E. Monatsschr. f. Unfallheilk, 1929, 36: 356.
35. Idem. Arch. f. path. Anat., 1929, 272: 61.
36. Brandes, K. Deutsche Ztschr. f. Chir., 1931, 231: 361.
37. Breton, M. J. de radiol. et d'électrol., 1929, 13: 277.
38. Brown, H. A. West. J. Surg., Obst. & Gynec., 1937, 45: 527.
39. Buchman, J. J. Bone & Joint Surg., 1925, 7: 814.
40. Ibid. 1927, 9: 55.
41. Buchman and Gittleman. Am. J. Dis. Child., 1930, 40: 1250.
42. Bucy, P. C. J. Am. M. Ass., 1930, 94: 1552.
43. Bufnoir and Legras. Rev. d'orthop., 1922, 9: 429.
44. Busch, E., and Christensen, E. Zentralbl. f. Neurochir., 1936, 1: 53.
45. Calvé, J. J. Bone & Joint Surg., 1925, 7: 41.
46. Idem. Bull. Soc. de pédiat. de Par., 1927, 25: 489.
47. Idem. Ostéo-chondrite vertébrale infantile. Robert Jones Birthday Volume, p. 315. London: Oxford University Press, 1928.
48. Idem. Brit. M. J., 1934, 2: 983.
49. Calvé, J., and Galland, M. J. de radiol. et d'électrol., 1922, 6: 21.
50. Idem. Presse méd., Par., 1927, 35: 1377.
51. Ibid., 1930, 38: 520.
52. Idem. Rev. d'orthop., 1930, 17: 723.
53. Ibid., 1931, 18: 782.
54. Idem. J. Bone & Joint Surg., 1930, 12: 555.
55. Idem. Rev. méd. franç., 1931, 12: 551.
56. Camp, J. D. Proc. Staff Meet. Mayo Clin., 1937, 12: 373.
57. Chasin, A. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1928, 37: 529.

58. CHIASSERINI, A. Policlin., Rome, 1937, 44: sez. prat. 1072.
59. CLYMER, G., MIXTER, J. W., and MELLA, H. Arch. Neurol. & Psychiat., 1921, 5: 213 (transactions).
60. COGGESHALL, H. C., and STORCH, I. J. C. VON. Arch. Neurol. & Psychiat., 1934, 31: 611.
61. COLANERI, L. J. Bull. et mém. Soc. de radiol. méd. de France, 1931, 19: 35.
62. CORNIL, L., and FRANCFORT, H. Presse méd., Par., 1925, 16: 243.
63. Idem. Rev. neurol., 1927, 2: 699.
64. CROUZON, O., PETIT-DUTAILLIS, D., and CHRISTOPHE, J. Rev. neurol., 1931, p. 612.
65. CUNNINGHAM. Textbook of Anatomy, 7th Ed. London: Oxford University Press, 1937.
66. DANDY, W. E. Ann. Surg., 1918, 68: 5.
67. Idem. Arch. Surg., 1929, 19: 660.
68. DARIER, I. Bull. et mém. Soc. anat. de Par., 1893, p. 22.
69. DAUSSET. Bull. et mém. Soc. de radiol. méd. de France, 1931, 19: 232.
70. DE BERNARDI, R. Arch. di radiol., 1931, 7: 537.
71. DELAHAYE, A. Etude sur quelques diagnostics du Mal de Pott, en particulier sur l'épiphysite vertébrale de croissance. Thèse de Paris, 1924. Legrand.
72. Idem. J. de radiol. et d'électrol., 1931, 15: 665.
73. DE PUKY, P. Acta orthop. Scand., 1935–1936, 6: 338.
74. DERSELBE. Arch. f. orthop. Chir., 1930, 28: 717.
75. DICKSON, W. E. C. Proc. Roy. Soc. Med., Lond., 1935–1936, 29: 1461.
76. DITTRICH. Verhandl. d. deutsch. orthop. Gesellsch., 1929, Kong. 23, p. 295.
77. DITTRICH, R. Am. J. Surg., 1929, 7: 840.
78. DONATI, M. Arch. ital. di chir., 1927, 18: 560.
79. ECKARDT, F. Arch. f. Kinderh., 1932–1933, 98: 81.
80. EDELSTEIN, J. M. Brit. J. Surg., 1934–1935, 22: 119.
81. EICHELBAUM, K. Zentralbl. f. Chir., 1937, 64: 2894.
82. ELLIOTT, G. R. Am. J. Orthop. Surg., 1906, 3: 303.
83. ELSBERG, C. A. Diagnosis and Treatment of Surgical Diseases of the Spinal Cord and its Membranes; p. 238. Philadelphia & London: W. B. Saunders Co., 1916.
84. Idem. Surg., Gynec. & Obst., 1928, 46: 1.
85. Idem. Bull. Neurol. Inst. New York, 1931, 1: 350.
86. ELSNER, J. Ztschr. f. orthop. Chir., 1913, 32: 277.
87. FICK, R. Handbuch der Anatomie und Mechanik der Gelenke. Unter Berucksichtigung der bewegenden Muskeln. Jena: G. Fischer, 1911.
88. FILIPPI, A. Chir. d. organi di movimento, 1936, 21: 1.
89. FINCHER, F., and WALKER, E. B. South. M. J., 1938, 31: 520.
90. Idem. South. Surgeon, 1938, 7: 97.
91. FITTE, M. J. An. d. Inst. munic. de radiol. y fisioterap., 1936, 2: 255.
92. FLEISCHER, F. Wien. med. Wchnschr., 1925, 75: 2721.
93. FLOTHOW, P. G. Northwest Med., 1938, 37: 14.
94. FRAENKEL, E. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1903, 7: 62.
95. FRIED, E. Contribution à l'étude des hernies intraspongieuses du disque intervertébral de l'adulte. Thèse de Strasbourg, 1932.
96. FURLOW, L. T. Tri-State M. J., 1938, 10: 2073.
97. GADOW, H. F. The evolution of the vertebral column; a contribution to the study of vertebrate phylogeny. Ed. Gaskell & Green. Cambridge: The University Press, 1933.
98. GALLAND. Arch. franco-belges de chir., 1930, 32: 479.
99. Idem. Bull. et mém. Soc. de méd. de Par., 1930, No. 2: 58.
100. Ibid., No. 9, p. 275.
101. Idem. Scalpel, 1930, 84: 1309.
102. Idem. Presse therm. et climt., 1931, 72: 254.
103. GALLI, R. Chir. d. organi di movimento, 1931, 15: 575.
104. GEIST, S. H. J. Am. M. Ass., 1931, 96: 1676.
105. GENDREAU, J. E., JUTRAS, and DUFRESNE. L'Union médicale du Canada, 1936, 65: 207.
106. GIONGO, F. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1928, 37: 873.
107. GLOBUS, J. H., and STRAUSS, I. Arch. Neurol. & Psychiat., 1929, 21: 1331.
108. GLORIEUX, P. La hernie postérieure du ménisque intervertébral. Paris: Masson & Cie., 1937.
109. GOLDTHWAIT. Boston M. & S. J., 1911, 164:365.
110. GOTTLIEB, F. Rev. d'orthop., 1938, 25: 519.
111. GRAY. Anatomy, Descriptive and Applied. 19th Ed., London: Longmans, Green and Company, 1916.
112. GUENTZ, E. Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1931, 42: 490.
113. HADLEY, L. A. J. Am. M. Ass., 1938, 110: 275.
114. HAEBLER, C. Roentgenpraxis, 1938, 10: 153.
115. HAGUENEAU, J. Monde méd., Par., 1936, 46: 825.
116. HALL, E. W. Am. J. Roentgenol., 1933, 30: 609.
117. HAMPTON, A. O., and ROBINSON, J. M. Am. J. Roentgenol., 1936, 36: 782.
118. HANSON, R. Acta chirurg. Scand., 1926, 60: 309.
119. Idem. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1929, 39: 1079.
120. HARKINS, H. N. Arch. Neurol. & Psychiat., 1934, 31: 483.
121. HARTMANN, H., and MONOD, R. Bull. et mém. Soc. anat. de Par., 1911, 86: 733.
122. HAWK, W. A. Brain, 1936, 59: 204.
123. HELD, H. J. VON. Deutsche Ztschr. f. Chir., 1933, 242: 675.
124. HETZAR, W. Beitr. z. klin. Chir., 1934, 160: 13.
125. HEUER, F. Ztschr. f. orthop. Chir., 1929, 52: 374.
126. HITCHCOCK, H. H. West. J. Surg., Obst. & Gynec., 1937, 45: 353.
127. HOFFMANN, V. Quoted by Lyon, E. Ztschr. f. Kinderh., 1932, 53: 570.
128. HORENSTEIN, V. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1926–1927, 35: 713.
129. ISRAELSKI, M., and POLLACK, H. Beitr. z. klin. Chir., 1930, 150: 476.
130. JACOBI, H. Beitr. z. path. Anat. u. z. allg. Path., 1927, 78: 303.
131. JAEGER, J. R. Rocky Mountain M. J., 1938, 35: 205.
132. JANAUD, P. Contribution à l'étude de l'épiphysite vertébrale douloureuse des adolescents. Thèse de Paris, 1929. Arnette.
133. JANKER, R. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1930, 41: 597.
134. JOISTEN, C. Arch. f. Orthop., 1930, 28: 622.
135. JOPLIN, R. J. Surg., Gynec. & Obst., 1935, 61: 591.
136. JUNGHANNS, H. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1930, 42: 704.
137. Ibid., p. 333.
138. Ibid., 1931, 43: 275.
139. Idem. Arch. f. klin. Chir., 1930, 159: 423.
140. Ibid., 1931, 165: 303; 166: 106; 166: 120.
141. Idem. Verhandl. d. deutsch. Roentg.-Gesellsch., 1931, 23: 29.
142. Idem. Roentgenpraxis, 1932, 4: 97.
143. Idem. Arch. f. orthop. u. Unfall.-Chir., 1937, 38: 1.
144. Idem. Rev. méd. german.-ibero-am., 1937, 10: 172.
145. KAGAN, M. I. Ortop. i. travmat., 1937, 11: 19.
146. KEYES, D., and COMPERE, E. J. Bone & Joint Surg. 1932, 14: 897.

147. KIENBOECK, R. Roentgendiagnostik der Knochen- und Gelenkkrankheiten. Heft 4. Degenerative Wirbelsaeulenerkrankungen. Berlin: Urban & Schwarzenberg, 1936.
148. KLAR, M. M. Med. Welt, 1931, 5: 558.
149. KLOTZ. J. Exper. M., 1905, 7: 633.
150. KNAGGS, L. Diseases of Bone. Bristol: John Wright & Sons, 1926.
151. KOCHER, T. Quoted by Middleton and Teacher. Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1896, 1: 420.
152. KOCHS, J. Arch. f. orthop. u. Unfall.-Chir., 1927, 24: 95.
153. KOHLMANN, G. Muenchen. med. Wchnschr., 1930, 77: 2211.
154. Idem. Verhandl. d. deutsch. Roentg.-Gesellsch., 1931, 23: 48.
155. KORTZEBORN, A. Zentralbl. f. Chir., 1930, 57: 2418.
156. KRABBE, K. Le compressioni midollari da spondilite deformante. Meddelelser fra Universitetets pskiatriska laboratorium og Kommunehospitalets nerve-sindyssygeafdeling. Vol. 5. Copenhagen: 1930.
157. KREBS, W. Deutsche med. Wchnschr., 1930, 56: 220, 270.
158. Idem. Rheumaproblem, 1931, 2: 163.
159. KRONENBERGER, F. Roentgenpraxis, 1929, 1: 898.
160. LABALT. Quoted by Smith, N. R. (1931). Med. Gazette, 1835–1836, 17: 341.
161. LAMBRINUDI, C. Brit. M. J., 1934, 2: 800.
162. LAMY, L. Arch. franco-belges de chir., 1928, 31: 191.
163. LANCE. Bull. Soc. de pédiat. de Par., 1922, 20: 43.
164. Ibid., p. 385.
165. Idem. Bull. et mém. Soc. nat. de chir., 1927, 53: 1380.
166. LANE, A. W. Tr. Path. Soc. Lond., 1886, 37: 387.
167. LANGERON, M. L. Bull. et mém. Soc. méd. d. hôp. de Par., 1936, 2: 1287.
168. LE DAMANY, P. Presse méd., Par., 1914, 2: 285.
169. LENSHOEK, C. H. Nederl. Tijdschr. v. Geneesk., 1937, 81: 4435.
170. LEROY, P. Rev. d'orthop., 1934, 21: 55.
171. LEWIN, P. Ann. Surg., 1925, 82: 286.
172. LIEK, E. Arch. f. klin. Chir., 1922, 119: 329.
173. LINDBLOM, A. F. Acta med. Scand., 1931, 76: 395.
174. LINDEMANN, K. Ztschr. f. orthop. Chir., 1932, 58: 54.
175. LJACHOVITZKY, M. Deutsche Ztschr. f. Chir., 1930, 224: 319.
176. LOB, A. Deutsche Ztschr. f. Chir., 1933, 240: 421.
177. LOVE, J. G. Proc. Staff Meet. Mayo Clin., 1936, 11: 529.
178. Ibid., 1937, 12: 369.
179. Ibid., 1938, 13: 404.
180. LOVE, J. G., and CAMP, J. D. J. Bone & Joint Surg., 1937, 19: 776.
181. LOVE, J. G., and WALSH, M. N. J. Am. M. Ass., 1938, 111: 396.
182. LUSCHKA, H. Die Halbegelenke des menschlichen Koerpers. Berlin: G. Reimer, 1858.
183. Idem. Arch. f. path. Anat., 1856, 9: 311.
184. LUSSKIN, H. Am. J. Surg., 1927, 3: 148.
185. LYON, E. Arch. f. Orthop., 1928, 26: 295.
186. Ibid., 1930, 28: 717.
187. Idem. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1929, 40: 635.
188. Ibid., 39: 76.
189. Idem. Roentgenpraxis, 1930, 2: 1067.
190. Idem. Ztschr. f. Kinderh., 1932, 53: 570.
191. LYON, E., and MARUM, G. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1931, 44: 498.
192. MANTOVANI, D. Arch. franco-belges de chir., 1930, 32: 488.
193. Idem. Riv. di radiol. e fis. med. (Supp. No. 1) 1930, 2: 8.
194. MARDESTEIG, K. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1935, 52: 278.
195. MARSILLE, L. A. Etude sur la pathologie du nucléus pulposus intervertébral. Les hernies nucléaires intraspongieuses. La cyphose à rétropulsion nucléaire et paraplégie. Thèse de Paris, 1932. Jouve.
196. MATHIEU, P., MASSART, R., and DUCROQUET, R. Bull. et mém. Soc. nat. de chir., 1925, 51: 220.
197. MAU, C. Ztschr. f. orthop. Chir., 1924–1925, 46: 145.
198. Ibid., 1929, 51: 106.
199. Ibid., 1931, 55: 62.
200. Idem. Muenchen. med. Wchnschr., 1925, 72: 211.
201. Idem. Zentralbl. f. Chir., 1928, 55: 386.
202. MAUCLAIRE and MISSET. Rev. d'orthop., 1931, 18: 790.
203. MAURIC, G. Le disque intervertébral. Paris: Masson & Cie., 1933.
204. MEZZARI, A. Quaderni radiologiei, 1932, 3: 137.
205. MICHAJLOW, M., and TSCHEREPNINA. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1929, 40: 1061.
206. MIDDLETON, G. S., and TEACHER, J. H. Glasgow M. J., 1911, 76: 1.
207. MILLER, J. L. Arch. Int. Med., 1934, 54: 161.
208. MILWARD and GROUT. Lancet, 1936, 231: 183.
209. MINOT, C. S. Anat. Record, 1906, 1: 42.
210. MIXTER, W. J. Ann. Surg., 1937, 106: 777.
211. MIXTER, W. J., and AYER, J. B. New England J. Med., 1935, 213: 385.
212. MIXTER, W. J., and BARR, J. S. New England J. Med., 1934, 211: 210.
213. MOCQUOT, P., and BAUMANN, J. Rev. d'orthop., 1931, 18: 649.
214. MONEY, R. A. Med. J. Australia, 1938, 1: 571.
215. MOONEY, A. C. Brit. J. Radiol., 1937, 10: 389.
216. MOONS, E., VAN BOGERT, L., and NYSSEN, R. J. de neurol. et de psychiat., 1927, 33: 58.
217. MOREL and ROEDERER. Bull. et mém. Soc. de radiol. méd. de France, 1932, 20: 114.
218. MOUCHET, A., and NADAL, R. J. de radiol. et d'électrol., 1931, 15: 565.
219. MUELLER, W. Beitr. z. klin. Chir., 1928, 145: 191.
220. Idem. Ztschr. f. orthop. Chir., 1931, 55: 351.
221. MUSGROVE, J. J. Anat. & Physiol., 1891, 25: 386.
222. NAFFZIGER, H. C., INMAN, V. T., and SAUNDERS, J. B. DE C. M. Surg., Gynec. & Obst., 1938, 66: 288.
223. NICOTRA, A. Radiol. med., 1929, 16: 977.
224. NIEDNER, F. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1933, 47: 70.
225. NORLEN, S. Hygeia, 1927, 89: 159.
226. ODIN, M., RUNSTRÖM, G., and LIMBLOM, A. Acta radiol., 1929, 7: Supp. 7, p. 1.
227. OLIN, H. A. Industrial Med., 1937, 6: 401.
228. OPPENHEIMER, A., and TURNER, E. L. Am. J. Roentgenol., 1937, 37: 484.
229. OVERGAARD, K. Acta radiol., 1938, 19: 143.
230. PALTRINIERI, M. Chir. d. organi di movimento, 1937, 23: 97.
231. PAPE, R. Fortschr. a. d. Geb. d. Roentgenstrahlen 1929, 39: 1066.
232. PEASE, C. N. Am. J. Dis. Child., 1935, 49: 849.
233. PEET, M. M., and ECHOLS, D. H. Arch. Neurol. & Psychiat., 1934, 32: 924.
234. PETIT-DUTAILLIS, D. Bull. et. mém. Soc. nat. de chir., 1928, 54: 1452.
235. PETTER, C. K. J. Bone & Joint Surg., 1933, 15: 365.

236. POLGAR, F. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1929, 40: 292.
237. POPPEN, J. L. Surg. Clin. North Am., 1938, 18: 879.
238. PUESCHEL, J. Beitr. z. path. Anat. u. z. allg. Path., 1930, 84: 123.
239. PUKY, K. VON. Frankfurt. Ztschr. f. Path., 1929, 37: 562.
240. RACANSKY, F. Časop. lék. česk., 1936, 75: 1406.
241. RATHCKE, L. Beitr. z. path. Anat. u. z. allg. Path., 1931, 87: 737.
242. Idem. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1932, 46: 66.
243. REGENSBURGER. Arch. f. klin. Chir., 1937, 189: 695.
244. RIETEMA, L. P., and KEIJSER, S. Nederl. Tijdschr. v. Geneesk., 1928, 72: 1472.
245. RINEHART, J. F., and Others. Arch. Int. Med., 1938, 61: 537.
246. ROBIN, C. Mémoire sur l'évolution de la notochorde, des cavités des disques intervertébraux et de leur contenu gélatineux. Paris: Baillière, 1868.
247. ROCHER, H. L., and ROUDIL, G. Bull. et mém. Soc. de radiol. méd. de France, 1932, 20: 235.
248. ROEDERER, C. Bull. et mém. Soc. de chir. de Par., 1931, 23: 596.
249. Idem. Bull. et mém. Soc. de radiol. méd. de France, 1930, 18: 224.
250. Idem. Rev. d'orthop., 1931, 18: 786.
251. ROKITANSKY, C. Lehrbuch der pathologischen Anatomie. Wien: W. Braumueller, 1855.
252. ROSE, G., and MENTZINGEN, A. VON. Chirurg, 1930, 2: 19.
253. ROSE, G., and MENTZINGEN, A. VON. Chirurg, 1930, 2: 418.
254. ROUVIÈRE. Compt. rend. Soc. de biol., 1921, 85: 156.
255. ROUVIÈRE, H., and DELON, L. Écho méd. du nord, 1936, 5: 837.
256. ROVEKAMP, T. Roentgenpraxis, 1930, 2: 186.
257. RUBINO, A. Riv. di neurol., 1937, 10: 491.
258. SASHIN, D. Arch. Surg., 1931, 22: 527.
259. SCHACHTSCHNEIDER, H. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1936, 54: 107.
260. SCHANZ, A. Berl. klin. Wchnschr., 1907, 44: 986.
261. Idem. Jahrb. f. Kinderh. (Ergaenzungsheft), 1911, 73: 1.
262. Idem. Arch. f. klin. Chir., 1927, 148: 187.
263. Idem. Ztschr. f. orthop. Chir., 1930, 53: 42.
264. SCHAPIRA, C. Chir. d. organi di movimento, 1938, 23: 371.
265. SCHEUERMANN. Ztschr. f. orthop. Chir., 1921, 41: 305.
266. Idem. Arch. méd. belges, 1928, 81: 353.
267. Idem. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1931, 44: 233.
268. Idem. Acta orthop. Scand., 1934, 5: 161.
269. SCHILDBACH, J. Zentralbl. f. Chir., 1937, 64: 2086.
270. SCHMORL, G. Verhandl. d. deutsch. path. Gesellsch., 1927, 22: 250.
271. Idem. Verhandl. d. deutsch. orthop. Gesellsch., 1927, (1926) Kong. 21, p. 3.
272. Idem. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1928, 38: 265.
273. Ibid., 1929, 40: 629.
274. Ibid., p. 18.
275. Ibid., 1930, 41: 359.
276. Idem. Zentralbl. f. Chir., 1928, 55: 2305.
277. Idem. Arch. f. klin. Chir., 1928, 153: 35.
278. Ibid., 150: 420.
279. Ibid., 1931, 168: 806.
280. Idem. Arch. f. path. Anat., 1929, 274: 50.
281. Ibid., 1930, 275: 13.
282. Idem. Klin. Wchnschr., 1929, 8: 1243.
283. Ibid., 1932, 11: 1369.
284. Idem. Zentralbl. f. allg. Path. u. path. Anat., 1930, 47: 7.
285. Idem. Ztschr. f. orthop. Chir., 1931, 55: 274.
286. Idem. Beitr. z. klin. Chir., 1931, 151: 360.
287. Idem. Arch. f. orthop. u. Unfall.-Chir., 1931, 29: 389.
288. SCHMORL, G., and JUNGHANNS, H. Die Gesunde und Kranke Wirbelsaeule im Roentgenbild. Leipzig: Thieme, 1932.
289. SCHRADER, E. Ztschr. f. orthop. Chir., 1930, 53: 6.
290. Ibid., 1932, 58: 281.
291. Idem. Verhandl. d. deutsch. orthop. Gesellsch., 1933, Kong. 27, p. 148.
292. SCHULZE, K. Roentgenpraxis, 1937, 9: 461.
293. SCHWABE, R. Arch. f. path. Anat., 1933, 287: 651.
294. SEREGHI. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1927, 36: 353.
295. SHELDEN, CARMICHAEL, JR., and ADSON. Proc. Staff. Meet. Mayo Clin., 1938, 13: 241.
296. SHERWOOD, K., and BERENS, S. N. West. J. Surg., Obst. & Gynec., 1937, 45: 656.
297. SICARD, A. Bull. méd., Par., 1936, 50: 836.
298. SIMMONDS, M. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1903, 7: 51.
299. SLAUGHTER, R. F. South. M. J., 1937, 30: 803.
300. SMITH, N. R. Brit. J. Surg., 1931, 18: 358.
301. SORREL. Bull. et mém. Soc. nat. de chir., 1925, 53: 798.
302. SORREL. E., and SORREL-DÉJERINE. Rev. neurol., 1926, 2: 44.
303. Ibid., 1924, 1: 323.
304. SORREL, E., and DELAHAYE, A. Presse méd., Par., 1924, 32: 737.
305. STOOKEY. Arch. Neurol. & Psychiat., 1928, 20: 275.
306. TAMMAN, H. Arch. f. orthop. u. Unfall.-Chir., 1934, 34: 356.
307. UEBERMUTH, H. Ueber die Altersveraenderungen der menschlichen Zwischenwirbelscheiben und ihre Beziehung zu den chronischen Gelenkleiden der Wirbelsaeule. Ber. Verhandl. Saechs. Akad. Wissensch. Leipzig: Math-Phys. Klasse, 1929, 81: 111.
308. Idem. Arch. f. klin. Chir., 1929–1930, 156: 567.
309. VAN WAGENEN, W. P. Ann. Surg., 1934, 99: 939.
310. VERAGUTH, O. Schweiz. med. Wchnschr., 1929, 59: 155.
311. VESALIUS, A. De Humani corporis fabrica Libri septem. Basileae: Oporini, 1543.
312. VIRCHOW, R. L. K. Untersuchungen ueber die Entwickelung des Schaedelgrundes im gesunden und krankhaften Zustande und ueber den Einfluss desselben auf Schaedelform, Gesichtsbildung und Gehirnbau. Quoted by Love and Walsh. Berlin: G. Reimer, 1857.
313. VIRCHOW. Anat. Gesellsch. Verhandl., 1911, 25: 176.
314. WEIL, M. P., and LALANNE. Presse méd., Par., 1938, 46: 123.
315. WILES. Proc. Roy. Soc. Med., Lond., 1935, 28: 647.
316. WILLIAMS, L. W. Am. J. Anat., 1908, 8: 251.
317. WISSING, O. Acta path. et microbiol. Scand., 1931, 154: Supp. 3, p. 233.
318. WITTKOWSKY, C. Arch. f. klin. Chir., 1924, 129: 793.
319. WOLF, J. Ztschr. f. orthop. Chir., 1927, 488: 138.
320. WUSTMANN, O. Deutsche Ztschr. f. Chir., 1931, 231: 43.
321. YOUNG, P. R., and SCOTT, M. Am. J. Roentgenol., 1938, 39: 187.
322. ZATKIN, S. Fortschr. a. d. Geb. d. Roentgenstrahlen, 1929, 39: 657.
323. ZENO, L. O., and CAMES, O. Rev. de cirug., Mex., 1930, 9: 28.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Lewy, F. H.: The Localization of Intracranial Lesions. *Ann. Surg.*, 1939, 109: 28.

Pain referred to distant areas is a well known accompaniment of certain conditions. Quite frequently observed, but less often recognized, is an area of cutaneous hyperesthesia, the stimulation of which causes an excessive harassing pain. This pain lasts longer than the causative irritation and spreads into adjacent unstimulated areas. The term "hyperpathia" has been given to this phenomenon.

The correlation of intracranial lesions and areas of skin hyperpathia was investigated in 100 cases. In 79 of these, the lesions were found to be tumors. The exact shape of the skin areas varied, and the relationship was found to be an approximate one, but the area of hyperpathia gave sufficient indication of the region where the bone flap should be turned down. The majority of brain tumors with hyperpathia of the scalp were situated above, at, or just below the surface of the brain, often involving the meninges directly or indirectly.

Tumors of the cerebellum and of the sphenoid ridge should be localized more accurately than those in other areas. Tumors of the posterior fossa cause a hyperpathia in C. 2-4. Deep-seated cerebellar tumors producing traction on the tentorium showed, in addition, or exclusively, a circular hyperpathia over the forehead or above the eyes. In tumors of the sphenoidal ridge a sensory examination may be of help in determining whether or not the first division of the fifth nerve is involved.

Other areas of hyperpathia showing less localization were noted. Frontal lobe lesions were associated with hyperpathia of the corresponding side of the forehead, medial fossa lesions with an area in the temple, and temporal lobe lesions with an area behind the ear. Lesions of the central area caused hyperpathia of the lateral and central areas of the scalp, partially overlapping the area associated with parietal lesions above and posteriorly.

This method of correlation is of special value in the differential diagnosis of supratentorial and infratentorial lesions, in the finer localization of cerebellar and sphenoid-ridge tumors, and in the differentiation between neoplasms and vascular processes.

EDWARD S. PLATT, M.D.

Wolf, A., and Cowen, D.: Granulomatous Encephalomyelitis Due to a Protozoan (Toxoplasma or Encephalitozoon). II. Identification of a Case from the Literature. *Bull. Neurol. Inst. New York*, 1938, 7: 266.

A previous report of a case of necrotizing encephalitis due to a protozoan is reviewed, and similar cases appearing in the literature are discussed.

The case previously reported was that of a female infant dying at the age of one month with a widely disseminated encephalomyelitis. Intensive inflammation and necrosis were found in the periventricular white and gray matter and in the cerebral cortex. Miliary granulomas were scattered throughout the central nervous system. A moderate leptomeningitis was present near the parenchymal lesions. Necrotic and caseous patches of chorioretinitis were present in each eye. A protozoan parasite was found in the lesions in the nervous system and eyes.

Five cases from the literature are reviewed because of similarities to the authors' case. The case reported by Richter showed parasites in the lesions similar in appearance to those noted by the authors. The parasites were present in two forms, as single micro-organisms, and as a cluster of elements. A typical single element consisted of a small ovoid eosinophilic mass of protoplasm from 2 to 3 microns long and from 1.5 to 2.0 microns wide, with a rounded granule of chromatin near one pole. The clusters or cysts measured from 6 to 15 microns in diameter, and were composed of many single parasites apparently surrounded by a fine membrane. Since the cysts were observed free in the tissue, and also occasionally in the cytoplasm of a swollen cell, the nucleus of which was displaced peripherally, it is possible that the appearance of a cyst wall may be given by the remaining shell of a parasitized cell.

The identity of the causative organism is discussed, and it is left for future investigation and experimentation to determine whether the organism should be classed as a toxoplasma or an encephalitozoon.

EDWARD S. PLATT, M.D.

Craig, W. McK., and Kernohan, J. W.: Tumors of the Fourth Ventricle. *J. Am. M. Ass.*, 1938, 111: 2370.

Early diagnosis of tumors of the fourth ventricle is difficult because these tumors produce symptoms of increased intracranial pressure. Eighty-two cases in which operation was performed have been reviewed in an effort to emphasize any factors which may help in the recognition of the early symptoms and determination of the treatment. Frontal or occipital headache, non-projectile vomiting, ataxia, visual disturbances including diplopia and nystagmus, and the usual symptoms of intracranial hypertension were the outstanding clinical characteristics.

In the series of 82 cases, there were 31 medulloblastomas, 21 ependymomas, 4 oligodendrogliomas, 2 gliomas of the granular layer of the cerebellum, 1 epidermoid cyst, 3 hemangio-endotheliomas, 19 astrocytomas, and 1 papilloma of the choroid plexus. In most of the cases in which the entire tumor was removed the history indicated that the tumor had been present only a short time. It is also interesting to note that of the 31 medulloblastomas, 30 were

removed partially and 1 was removed entirely. Of the 21 ependymomas, 13 were removed partially and 8 were removed entirely. Of the entire group of astrocytomas, only 4 were removed entirely.

The survival period in the cases of medulloblastoma did not seem to depend on the amount of tumor which was removed, nor on the amount of high-voltage roentgen therapy given, but on the type of cells found. In the majority of cases of medulloblastoma the period of survival is from nine months to three years; in cases of ependymoma, however, the life expectancy is much longer, even in cases in which only part of the tumor is removed.

It generally has been thought that tumors of the fourth ventricle are more malignant than gliomas that are found elsewhere in the central nervous system. This may be, and undoubtedly is, true from the clinical and surgical points of view but cytologically it is not so. It is probably true, however, that medulloblastomas should be included in the group of highly malignant gliomas. These tumors have a tendency to implant themselves on the walls of the other ventricles and to be disseminated widely throughout the subarachnoid space. Medulloblastomas are supposed to respond better to roentgen therapy than other types of glioma.

Operation for the removal of a tumor of the fourth ventricle can be conducted with the patient in the upright or prone position. If the upright position is used, signs of changes in, or instability of, the blood pressure rarely develops and the operation can be carried out under either local or general anesthesia. The Cushing cross-bow incision has been replaced almost invariably by a simple curved incision which is started below the mastoid process on each side and curved upward to just below the occipital protuberance. In order to obtain adequate exposure of the tumor, sometimes it is necessary to divide the vermis. On the other hand, when the vermis and the inferior tonsils of the cerebellum are not herniated it is sometimes possible to remove the entire tumor without incising the vermis. It usually is necessary to aspirate the posterior horn of the lateral ventricle before the dura is opened. After the tumor of the fourth ventricle has been removed, air can be injected into the posterior horn of the lateral ventricle; when the air bubbles through into the fourth ventricle it demonstrates that the aqueduct of Sylvius is patent. Postoperative drainage is sometimes advantageous and can be accomplished either by means of a catheter which is left in the posterior horn of the lateral ventricle or a small collapsible Penrose drain in the fourth ventricle. Removal of the tumors of the fourth ventricle is carried out with suction and grasping forceps, and the authors have found that with care in controlling the hemorrhage very little electrocoagulation is necessary.

At the Mayo Clinic, the surgeons in general have been taught to, and now do, expect accurate diagnosis by examination of frozen sections of fresh tissue which have been removed for biopsy, and they plan their surgical procedures accordingly. The authors have been using polychrome methylene blue to stain frozen sections of fresh specimens of brain tumors for many years and have found it satisfactory. Aside from the fact that they have become used to this method, it has the advantage of allowing study of not only the individual cells, but also the architecture of the neoplasm. The relation of the cells to the walls of blood vessels, changes in the blood vessels (especially proliferation of endothelial cells of the intima), necrosis, and mitotic figures can also be studied. The stain does not, as a rule, demonstrate all the processes of the cells, but if the light which passes through the section is decreased it is possible to visualize most processes. There is little difficulty in arriving at a diagnosis of most tumors of the fourth ventricle with frozen sections of fresh tissue that are stained with polychrome methylene blue. Naturally, all such diagnoses are confirmed by examination of fixed tissues and such special staining methods as are available and seem indicated.

The object of operation in cases of tumor of the fourth ventricle is to relieve the internal hydrocephalus or the increased intracranial pressure and a conservative operation which opens the lower portion of the aqueduct of Sylvius may be followed by temporary relief. However, if the surgeon is made aware of the malignancy of the tumor during the operation, his method of attack and his attempt at radical removal are modified by the cytological character of the tumor encountered.

There is probably no other group of tumors in which postoperative irradiation is as important as in the tumors of the cerebellum and fourth ventricle. At times one is dealing with a tumor which is highly radiosensitive, that is, a medulloblastoma, and it may have been suggested that no operation be done, but that the patient should be subjected to at least three courses of irradiation. In some of the foreign clinics, whenever increased intracranial pressure without localizing signs develops in a child, irradiation without operation is advised. We do not agree with this procedure because some tumors of the more radioresistant type, with histories which reveal that they have been present only a short time, can be removed and a cure accomplished. However, in view of the fact that the majority of tumors which occur in the posterior fossa during childhood are medulloblastomas, irradiation after operation is usually indicated.

SPINAL CORD AND ITS COVERINGS

Zeno, L.: The Treatment of Spinal-Cord Injuries (Estado actual del tratamiento en los traumatismos raquimedulares). *An. de cirug.*, Rosario, 1938, 4: 298.

The author, after some theoretical and clinical considerations of his concept of the injuries and fractures of the spinal cord, summarizes his ideas about the treatment of these injuries in the following manner:

Uncomplicated or complicated fractures of the cervical spine should be treated by means of reduction, quick gradual correction, radiological control, and fixation in hyperextension by application of a Thomas collar.

The reduction is obtained through zenithal traction. Local anesthesia is not necessary. If there is a quadriplegia, the patient is seated with his trunk tilted forward. The cephalic plane is held in a horizontal level so as to determine the hyperextension of the spine. The patient is sustained by the cephalic suspension and by a bandage applied between the thorax and the chair. If necessary, a nurse can support the arms in full abduction. The zenithal traction is made by means of an occipitomental sling. If the part belonging to the chin is put against the superior front teeth, the patient will be more comfortable. The skeletal traction from the parietal bones with "ice tongs" of the Boehler type is a real progress.

If the patient is in a state of shock the zenithal traction cannot be done. In this case permanent traction with an inclined bed must be done by means of skeletal traction in the Crutchfield way. Once the shock is over, the hyperextension can begin and as soon as the radiological controls show the necessary reduction, fixation is accomplished with a Thomas collar. Zeno thinks that besides the complicated spinal ligamentary system, the muscular tonus is an element that, even under narcosis, hinders a too large separation of the fragments which might endanger the integrity of the cord.

In injuries of the dorsal and lumbar spine the reduction maneuvers are inspired by the x-ray findings, which must be as precise and perfect as possible. The patient must be very carefully examined so that any other lesions that may require a surgical procedure before the reduction (ruptures of the liver, kidneys, and spleen) may be brought to light. One must not try to reduce the fracture during shock as the state of the patient may be aggravated.

The experience of the author induces him to say that the general principle of the zenithal traction is useful in this type of fracture even in cases with a bayonet displacement or with an important dislocation. He believes that this form of traction is tolerated better than the reduction in a recumbent position. The vertical traction alone does not allow a correction in hyperextension. However, this position is possible by means of an oblique position of the patient under suspension, as in cervical lesions.

The vertical traction would hinder the complications that have been described by some authors and originated in the comminuted fractures by the displacement of some fragments toward the spinal cord during the reduction in hyperextension.

The author does not try to produce fixation immediately in hyperextension. This position is not imperative at first; besides, it very often brings pain which sometimes becomes intolerable, especially by distention of the abdomen. If the hyperextension seems to be indispensable, it can be done in four or five days, thereby sparing the patient a very unpleasant experience. The benefits of a plaster fixation must not be forgotten.

Once the cast has been set and as soon as the patient recovers from the psychic shock, the ambulatory and functional treatment can begin. Also, in some special cases, and as a psychic stimulant, the patient can start to walk with the help of a rolling support. If there is urinary retention, the suprapubic drain made with a vesical fistula is preferred.

In the transverse fractures, the author corrects the antalgic position with local anesthesia and then fixes the spine with a cast. The patient is allowed to stand up and walk at once with good results. Some very interesting reports show the results of this method.

HECTOR MARINO, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Dunphy, J. E.: The Surgical Importance of Mammary and Subcutaneous Fat Necrosis. *Arch. Surg.*, 1939, 38: 1.

A thorough knowledge of the pathogenesis and clinical manifestations of fat necrosis is of considerable surgical importance because all too frequently the similarity of this condition to cancer has led to ill advised surgical intervention or irradiation therapy. This is true particularly of fat necrosis in the breast. However, fat necrosis may prove to be equally baffling when it occurs in a mastectomy scar, in a lipoma, in a hernial sac, or deep in the subcutaneous tissues of the thigh or buttock.

The condition has been described under a number of titles, of which the most familiar are: traumatic fat necrosis, ischemic fat necrosis, and lipogranulomatosis. Since fat necrosis is not a true granuloma, and since it may occur independently of proved trauma or ischemia, it seems better to designate it according to its anatomical location, as mammary or subcutaneous fat necrosis.

Usually fat necrosis appears as a solitary lesion, but its lesions may be multiple, especially in the newborn. In such patients it must be distinguished from sclerema and scleroderma neonatorum. It is a well defined entity; it is almost certainly the result of trauma; and, in contradistinction to scleroderma neonatorum, it has a uniformly good prognosis. In the adult, multiple areas of fat necrosis are of rare occurrence, but they have been described as following infectious diseases. It is possible that such multiple areas of fat necrosis are the result of ischemia due to vascular lesions. Christian-Weber disease is included in this classification by some authorities.

The exact factors involved in the development of solitary lesions of fat necrosis have not been established. The lesion may arise after trauma; after the injection of foreign material, especially fats and oils; after interference with the blood supply to a part; or after infection. However, if any of these factors alone is sufficient to produce fat necrosis, it is difficult to understand the comparative rarity of the lesion, when one considers the frequency of trauma to, and infection in, subcutaneous fat. It seems likely, therefore, that in addition to these various exogenous factors, an endogenous factor is essential for the production of fat necrosis. The nature of this endogenous factor is hypothetical, but it may be a blood or tissue lipase which is more abundant or more easily activated in certain persons than in others.

The presence of fat crystals alone is not of sufficient histological evidence to warrant a diagnosis of fat necrosis. Also, after the injection of foreign material, especially fats and oils, an intense foreign-body reaction may be observed; such a reaction is not necessarily fat necrosis. In certain cases this foreign-body reaction becomes a progressive lesion which possesses the essential histological features of fat necrosis, but this is not always the case. The dissolution of normal fat cells into confluent spaces seems to be an essential characteristic of true fat necrosis. It apparently represents one of the earliest histological changes. Within these spaces are the products of decomposing fat, which usually excite a mild but slowly progressive foreign-body reaction. This is characterized chiefly by an infiltration of mononuclear phagocytes, many of which become filled with particles of necrotic fat. These so-called "foam cells" are found about the periphery of the broken-down fat. This is followed by proliferation of the surrounding connective tissue and, to some extent, of the fat cells. The cellular infiltration may be heavy, and in addition to the mononuclear phagocytes there may be numerous lymphocytes, plasma cells, and occasional polymorphonuclear leucocytes. In early fat necrosis, a stage not often seen histologically, polymorphonuclear leucocytes may be numerous. In a later stage, giant cells frequently constitute a prominent feature so that, in some instances, the lesion bears a superficial resemblance to tuberculosis. More commonly, however, as the lesion develops one finds many cyst-like areas of necrotic fat, surrounded by mononuclear phagocytes and giant cells, and separated by broad bands of proliferating connective tissue. These cystic areas may become macroscopically visible, but rarely exceed 1 cm. in diameter.

Obliterative endarteritis is occasionally associated with fat necrosis, particularly in the late stages. In some cases such vascular changes may constitute the causative factor. Usually, however, the obliteration of the vessels is an accompaniment of the contraction and hyalinization of the connective tissue, which occurs throughout the area of fat necrosis. In the very late stages, the cellular reaction may completely subside, leaving only the cyst-like areas, which are surrounded by dense, hyalinized acellular scar tissue. In this stage, areas of calcification are not uncommon.

The gross appearance of fat necrosis varies considerably, according to the stage in which it is observed. In the very early stages of fat necrosis the lesion may occupy exactly one or two fat lobules, appearing as a sharply demarcated, opaque area which stands out prominently against the normal fat which surrounds it. It is soon followed by a central liquefaction of the lesions, and then one finds a poorly demarcated, edematous area of fat in which minute cystic spaces are visible, and from which yellow, oily material may be expressed. Later, the induration becomes more striking, and the cut surfaces of the lesion contain well-defined cavities filled with serous fluid, oily, necrotic fat, or a grayish-

white, chalk-like débris. As the amount of connective tissue increases, a more homogeneous grayish-white appearance develops. There is also a gritty consistency, so that the tissue resists the blade of a knife in a manner much like that of scirrhous carcinoma. Even in this stage it is not likely that the experienced observer would mistake fat necrosis for carcinoma, but to one not familiar with it or not suspecting it, the condition may prove deceptive. It is possible to interpret areas of necrotic fat as tumor, and the correct diagnosis may be in doubt until a histological diagnosis is made. Consequently, a biopsy with histological examination of the tissue should be performed for suspected malignant tumor in those areas in which fat necrosis usually is encountered.

The incidence of fat necrosis cannot be accurately estimated because the lesion in many cases is not recognized. A considerable number of such lesions are treated as carcinoma. In the department of pathology of the Peter Bent Brigham Hospital, Boston, the diagnosis was made ten times between 1923 and 1937. A study of a number of lesions of fat, which had been diagnosed as chronic infection, revealed 6 additional cases.

Twelve of the patients were females, and 4 were males. The age incidence varied from sixteen to sixty-eight, the average being fifty. One patient was in the second decade of life, 5 were in the fourth, 6 in the sixth, and 4 in the seventh. There seemed to be no relation between occupation and the development of fat necrosis. All of the patients were white except 1, who was a negro. Six were described as obese, 9 were well developed and well nourished, and 1 was of thin, asthenic habitus. In the latter patient the lesion was secondary to chronic infection. As one would expect, those patients who have an abundant panniculus are more susceptible to fat necrosis. The duration of the lesion is of no striking diagnostic importance. In the present series, the nodule had been known to be present for periods varying from ten days to five years before operation had been performed. A history of some form of trauma was mentioned by only 6 of the 16 patients. Only 1 of the patients had syphilis. None had diabetes. In 6, a clinical diagnosis of carcinoma was made, and in 2, radical surgical operations without biopsy were done.

The series reported is representative of the various locations in which fat necrosis may arise. Of these, the breast assumes by far the greatest importance. In this location fat necrosis appears as a firm, often painless nodule which gradually or sporadically makes rapid increase in size. It may be situated in any quadrant of the breast. A definite history of trauma has been obtained in only 40 per cent of the reported cases. In more than 50 per cent the lesion has been adherent to the skin, and occasionally the typical "peau d'orange" appearance of cancer has been observed. In 10 per cent there has been retraction of the nipple, and in about the same proportion the lesion has been adherent to the deep tissues of the chest wall. A clinical diagnosis of fat necrosis of the breast is occasionally possible, particularly if, after trauma to the breast, a mass has developed rapidly and no involvement of the axillary lymph nodes is found. More often, however, the lesion is much like carcinoma in appearance, and only unusual circumspection will prevent an error. This means that for even a "typical carcinoma" of the breast a biopsy must be performed, and histological examination by means of frozen sections must be made before radical surgical treatment is given.

The development of fat necrosis in a mastectomy scar presents even greater difficulties in diagnosis, particularly if the mastectomy has been performed for carcinoma. There were 2 such cases in the present series, and it is likely that the condition is more common than has been realized. In this situation fat necrosis appears as a hard, irregular, nodular growth which is usually fixed to the chest wall. Unless the possibility of fat necrosis is kept constantly in mind, a diagnosis of recurrent carcinoma is inevitable.

Biopsy and histological examination of the tissue should be performed before surgical intervention or irradiation is employed in the treatment of a lesion suspected to be a recurrent carcinoma of the breast. It should be noted that fat necrosis may not develop for months or even years after trauma to the normal breast. Hence, in cases in which fat necrosis occurs in mastectomy scars, the length of time after operation which elapses before the lesion develops may be variable.

Elsewhere in the body, fat necrosis is less likely to be mistaken for a malignant neoplasm, but it may prove a baffling lesion.

Fat necrosis may occur (1) in an old incarcerated hernial sac, (2) in a lipoma, and (3) at any place where a nodular lesion develops after trauma or long-standing infection. In an old incarcerated hernial sac, either the omentum or the properitoneal fat is involved. Usually the condition manifests itself as a moderate induration of the fat and does not attract the attention of the operator, but in 1 case there was a solitary, whitish-gray, firm nodule fixed to the under surface of the hernial sac. It strongly suggested the seeding of an intra-abdominal tumor, and it might easily have led to an unnecessary exploration of the abdomen if its true nature had not been suspected and the diagnosis confirmed histologically. In a lipoma, areas of fat necrosis may impart an irregular nodular consistency to the tumor, causing it to be mistaken for a sarcoma.

The development of carcinoma in areas of chronic inflammation is a fairly common clinical observation. It is not generally known, however, that occasionally fat necrosis may arise in or adjacent to such areas. In the present series there were 3 instances of such origin, but in each case the small tumor mass which developed was interpreted as an indurated abscess cavity rather than a neoplasm. However, in view of the similarity which fat necrosis bears to neoplasm elsewhere in the body, it is not

unlikely that in certain cases it may also simulate malignant disease in this situation.

SAMUEL KAHN, M.D.

TRACHEA, LUNGS, AND PLEURA

Cann, R. J.: Basal-Celled Carcinoma of the Trachea. *Guy's Hosp. Rep.*, Lond., 1938, 88: 392.

The history of 2 cases of basal-celled tracheal tumor was recorded, together with a report on treatment and progress to date. The value of roentgenology of the trachea after the introduction of lipiodol was demonstrated; in 1 case the tumor was clearly outlined and its exact level shown.

Treatment of carcinoma of the trachea was also considered. One of the 2 cases was treated by deep x-ray therapy, the other by teleradium. In each case the tumor had apparently disappeared and obstruction had been relieved.

The pathology of carcinoma of the trachea was discussed and it was demonstrated that one of these tumors probably arose from the basal layer of the tracheal mucosa while the other probably arose from a mucous gland situated deep in the tracheal wall. The latter resembled closely the structure of the mixed tumors occurring in the parotid and other salivary glands. PAUL MERRELL, M.D.

Lardennois, G., Monod, O., and Garcia-Bengochea, J.: Extrapleural Oleothorax (L'oléothorax extrapleural). *Ann. méd.-chir.*, Par., 1938, 3: 317.

This report emphasizes the danger of repeated intrapleural oleothorax in patients with active tuberculous lesions in whom pneumothorax has been found to be ineffective. The authors have tried extrapleural injections (i.e., into the lung cavities themselves) of iodized oil and have found the results to be satisfying. They prefer to make repeated injections of small quantities of the oil, leaving an air space above, and they have found healing to be rapid and complicated by few or no ill effects of the oil. They use a small amount of iodized vegetable oil combined with a larger quantity of gomenol. Eventually, with healing and filling out of the cavity by lung expansion, the oil is absorbed completely. This alone makes its use preferable to paraffin.

In the opinion of the authors, oleothorax has for its object the avoidance of too rapid a collapse of the cavity. It is "blockage" therapy, not intended to be a substitute for insufflation, but to be used as a forced measure of necessity when the eventual result of thoracoplasty may be unsuccessful.

JOHN MARTIN, M.D.

Letulle, R.: Micro-Organisms of Abscesses of the Lung (Les microorganismes des abcès du poumon). *Presse méd.*, Par., 1938, 46: 1779.

Letulle notes that the organisms causing abscesses of the lung are of two main types: pyogenous organisms, including bacilli and entameba histolytica; and anaerobic organisms, including the anaerobic bacilli and spirochetes.

The pyogenous bacilli most frequently found in pulmonary abscesses are pneumococci, streptococci, enterococci, staphylococcus aureus, and the Friedlaender pneumobacillus. The clinical characteristics of pulmonary abscesses due to these various organisms are not distinctive except in the case of the Friedlaender bacillus. It may sometimes be difficult to differentiate the pneumococci isolated from the pus of a pulmonary abscess from streptococci unless they are typically encapsulated. In such cases, they are best differentiated either by the Neufeld test (lysis of pneumococci by bile) or by animal inoculation. The streptococci in pulmonary abscesses are chiefly of the viridans or the hemolytic type. Pulmonary abscesses due to the Friedlaender pneumobacillus may almost be called diffuse abscesses; the lesions are markedly necrotic and hemorrhagic; if the patients survive there is usually extensive cicatrization or cavity formation.

Pulmonary abscess due to entameba histolytica is usually secondary to hepatic abscess, but may be caused by an amebic embolus originating in the intestines. In either case the abscess is necrotic and hemorrhagic, and the expectorated pus viscid and dark colored. The amebæ can be demonstrated in the expectorated pus only if examination is made when the specimen is freshly obtained.

The anaerobic flora found in pulmonary abscesses is abundant and varied; among the anaerobic bacilli are the bacillus perfringens, bacillus ramosus, and bacillus fusiformis, the anaerobic streptococcus, and the spirillum nigrum. Pulmonary abscesses due to these anaerobic organisms are characterized by septic necrosis and a putrid odor of the breath. These anaerobic organisms alone may produce septic necrosis or gangrene of the lung, but they are also frequently associated with spirochetes. The spirochetes of pulmonary abscesses and gangrene show marked polymorphism; some authorities consider that these spirochetes are of the type of spirochæta bronchialis described by Castellani; others that they are Vincent's spirochetes, found in association with the fusiform bacilli in Vincent's angina and other lesions of the upper respiratory tract. ALICE M. MEYERS.

Brock, R. C., and Cann, R. J.: Experiences with the Use of Intrabronchial Radon in the Treatment of Bronchial Carcinoma. *Guy's Hosp. Rep.*, Lond., 1938, 88: 371.

Bronchial carcinoma is a relatively common disease and usually of such an insidious onset that by the time the correct diagnosis has been made the sufferer is almost always beyond the help of any but the simplest of palliative measures. Of 106 consecutive cases studied by the author, 93 were considered to be inoperable. In view of this high percentage of patients unsuitable for radical surgery, it is important to consider the value of other methods of treatment in the relief of symptoms and prolongation of life.

Yankauer, in 1922, was the first to use radium by intrabronchial surface application. In 1924 Green

reported a case in which he inserted radon seeds directly into the substance of an intrabronchial polypoid tumor. Tudor Edwards, in 1929, introduced some special radon-seed containers which could be left in place for as long as a week. A central lumen allowed air and secretions to pass through, the seeds being held in four grooves in the wall over which an outer case was fitted. The original tubes were made of German silver and experience showed that the imperfect screenage and secondary radiation were dangerous. For this reason, the authors state, they had tubes made with an outer protective sheath of platinum and this, with another sheath of platinum covering each seed, made a total of 0.6 mm. of platinum screenage. They found it necessary to employ a large tracheoscope for the instillation of the tubes.

The dosage advised by Edwards was 12 seeds of 1.5 mc. strength, to be left in place for from five to seven days. The authors state they had been using seeds with a strength of 1 mc., which often measured as high as 1.25 mc. rather than those having a strength of 1.5 mc., which were often found to have an actual strength of 1.8 or even 2 mc. The container is left for seven days. Certain disadvantages are inherent to the use of radon as opposed to radium: (1) the uncertainty and variability of the dosage, and (2) the rapid diminution of strength.

Twenty-five cases were treated by the authors and they describe 6 of them. It is pointed out that the best results from intrabronchial radon therapy are to be expected in cases of squamous-cell bronchial growths in elderly men, which are rather slow-growing. Intrabronchial radon should not be used in preference to radical surgery in a patient who is fit or suitable to undergo operation.

PAUL MERRELL, M.D.

Dorfman, L. L.: The Fate of Remaining Portions of the Lungs and Stump Shortly after Lobectomy and Pulmonectomy. *Vestnik khir.*, 1938, 56: 194.

The author studied the effect of lobectomy or pulmonectomy on the remaining portions of the lungs by experimenting on 17 cats. The operation was performed under a combined ether-chloroform anesthesia and artificial respiration. For the latter purpose either a tracheotomy or intubation was used and the cannulas were connected with a suitable apparatus. The pleural space was entered through a curved incision in the fifth or sixth intercostal spaces; a silk ligature was applied to the main bronchus; and one lobe or the entire lung was removed. The wound was closed without drainage with a continuous catgut stitch including the adjoining rib, and interrupted silk stitches were applied to the skin.

Histological studies of the remaining lung or stump were made at various times after the operation. The experiments were supplemented by similar operations on 6 dogs. The author comes to the following conclusions:

A wide exposure of the chest cavity, an excessive separation of the ribs, tension on the lobe to be removed, and its ligation at the hilus cause in the majority of cases a sudden cessation of respiration and an increase in the cardiac rate. The removal of one or several lobes causes a compensatory hypertrophy and emphysema of the remaining portions of the lung and a new formation of elastic fibers in the interalveolar septa. Starting within the first twenty-four hours after the lobectomy, a necrosis of the stump develops and lasts a long time. In one instance signs of necrosis were detectable one and one-half months after the operation. The process of cicatrization begins only toward the end of the second month. The long duration of the necrosis may be responsible for a purulent pleurisy, but in many instances adhesions between the pleura and the stump prevent such complications.

JOSEPH K. NARAT, M.D.

HEART AND PERICARDIUM

Gross, R. E., and Hubbard, J. P.: Surgical Ligation of a Patent Ductus Arteriosus. *J. Am. M. Ass.*, 1939, 112: 729.

The authors report a case of a girl seven and one-half years old who was known to have a patency of the ductus arteriosus and a beginning cardiac hypertrophy. They performed an operation in the hope of preventing subsequent bacterial endarteritis and with the immediate purpose of reducing the overwork of the heart caused by the shunt between the aorta and pulmonary artery. The ductus was surgically explored and ligated. The patient stood the operative procedure exceedingly well and showed no signs of shock. There was only a mild discomfort on the afternoon of the day of operation, and on the following day the child was allowed to sit up in a chair. On the third day she was walking about the ward.

The most marked objective finding, which indicated that the serious loss of blood from the aorta into the pulmonary artery had been arrested by operation, was obtained by a comparison of the preoperative and postoperative levels of the diastolic blood pressure. Prior to operation the daily blood pressure showed an average diastolic level of 38 mm. of mercury, but after operation the diastolic level quickly went up to 80 mm. of mercury. This is the first patient in whom a patent ductus arteriosus has been successfully ligated.

J. DANIEL WILLEMS, M.D.

Bigger, I. A.: Heart Wounds. *J. Thoracic Surg.*, 1939, 8: 239.

The author discusses the treatment of patients with heart wounds, and records 4 illustrative cases in detail. He also suggests a plan whereby such cases may be divided into 4 groups depending upon whether there is free communication with the pleura or tamponade, and also upon the blood loss and the severity of the tamponade.

Patients in whom there is free communication with the pleura but only slight or moderate hemorrhage are classified as belonging to Group I and treated conservatively.

Group II includes those patients with tamponade, but in whom there is marked improvement, including a rise in blood pressure to near normal following venoclysis, adrenalin, and morphine. These patients are prepared for operation, but before the operation is begun a cannula is inserted into the pericardium, the pressure is obtained, and, if possible, sufficient blood is removed to decrease the intrapericardial pressure appreciably. The cannula is then left in place for from fifteen to thirty minutes, to determine whether or not there will be a rapid recurrence of the tamponade. If it recurs promptly, operation is done, but if the pressure remains low, conservative treatment is continued.

Group III includes those patients with greatly increased intrapericardial pressure, who do not show a satisfactory response to conservative measures, and who continue to have a low arterial pressure. They should be operated upon without delay.

Group IV includes those patients with free communication to the pleura, and massive intrapleural hemorrhage. They should be operated upon immediately, and re-infusion of the blood in the pleural cavity should be undertaken while an attempt is made to control the hemorrhage. The number of patients who will survive from this type of injury is small.

The author also finds in response to a questionnaire which he sent to members of the American Association for Thoracic Surgery, the American Surgical Association, and the Southern Surgical Association, that of 141 patients with heart wounds, operated upon by the members of these associations, 71 recovered and 70 died. This he considers a very accurate index of the chances of recovery following operations for heart wounds.

J. Daniel Willems, M.D.

ESOPHAGUS AND MEDIASTINUM

Flynn, R.: Achalasia of the Esophagus. *Australian & New Zealand J. Surg.*, 1939, 8: 244.

Achalasia of the esophagus ranks next in frequency to carcinoma as a cause of esophageal obstruction. In this lesion, the absence of relaxation of the cardiac sphincter in the act of deglutition causes food to be retained in the esophagus, the peristaltic force of which is not sufficient to overcome the resistance of the sphincter. This resistance in achalasia can be overcome only by a pressure equal to about 20 cm. (8 in.) of water. Consequently, no food will pass the sphincter until this pressure obtains, at which time the cardia opens and allows food to pass until the weight of the column of food is reduced to less than 20 cm., or approximately equal to a column of food 8 in. above the cardia.

Various theories and descriptions of this condition have been given since Purton first reported the syndrome in 1821. The earliest plausible approach to the etiology was the conclusion of Einborn in 1888 that there was a "lack in the reflex relaxation or opening of the cardia during the act of swallowing." He pointed out that Kronecker and Meltzer had shown that "every act of swallowing easily opens the cardia by reflex action." Hurst, in 1913, in the course of a discussion said that after examining the specimens of so-called cardiospasm in the museum of Guy's Hospital, he had come to the conclusion that the condition could not arise from a spasm of the cardiac sphincter, which was the commonly accepted view. As the symptoms were often present for many years before death, it was quite inconceivable that a spasm of such long duration should not lead to hypertrophy of the cardiac sphincter. Yet, in all the specimens he had examined, the absence of hypertrophy of the cardia and the absence of any obvious obstruction after death had been in striking contrast with the degree of hypertrophy of the esophageal wall. As a result of these observations, he came to the conclusion that the condition was due to the absence of the normal relaxation which should occur when each peristaltic wave traveling down the esophagus reached the cardiac sphincter, or, in other words, to an inco-ordination or, as Parkes Weber suggested, a dissociation of the neuromuscular mechanism of the distal end of the esophagus.

It was observed that as a result of this inco-ordination or dissociation, the esophagus becomes atonic, dilated, and elongated, and reaches a maximum diameter immediately above the diaphragm, or it becomes S-shaped with the dilated portion lying over the right dome of the diaphragm. The dilatation generally extends as high as the third dorsal vertebra.

Acting on Hurst's impressions, Rake, in 1929, demonstrated in 6 cases well marked inflammatory and degenerative changes in the lower end of the esophagus, particularly involving Auerbach's plexus.

The nerve supply to the esophagus is still a matter of controversy. The most complete study was published by Knight in 1934. He concluded that the esophagus receives a sympathetic innervation. There is a true intrinsic sphincter at the cardia and vagal stimulation augmented by sympathetic stimulation causes tetanic contraction of the striped muscle composing the upper third of the esophagus. Vagal stimulation causes increased tonus and mobility of the plain muscle of the lower third of the esophagus, but this is inhibited by sympathetic stimulation. Complete bilateral vagal section reproduced achalasia of the cardia and simultaneous removal of the sympathetic fibers prevented it. When achalasia develops, it is thought that section of the sympathetic supply to the sphincter of the cardia where it passes to it from the celiac axis and left gastric arteries will relieve it.

The disease occurs in both sexes equally often, and in patients of all ages. Moersch reported the onset of symptoms before the age of fourteen years, and in Plummer's series, the average age of onset was

twenty-nine years. The course of the disease may be divided into three stages: (1) achalasia without regurgitation of food, characterized clinically by a complaint of discomfort behind the lower end of the sternum; (2) achalasia with immediate regurgitation of food; and (3) achalasia with dilatation of the esophagus, retention of food in the esophagus and its regurgitation at irregular intervals after ingestion, usually unmixed with gastric juice, but commonly mixed with mucus and saliva. An associated clinical finding which is most constant is hypertrophy of the salivary glands, especially the submaxillary glands.

A diagnosis of achalasia of the esophagus should not be made without roentgenographic evidence of obstruction at the cardia. Psychoneurotic individuals complain of retrosternal pain and obstruction to swallowing food without roentgenographic evidence of obstruction. The skiagram will show the lower end of the esophagus ending in a perfectly smooth funnel. The passage of a No. 45 Charriere olivary-tipped tube over a previously swallowed silk thread, without more than slight resistance at the cardia, is confirmatory evidence. Occult blood is never found. An ordinary bougie should not be passed since perforation of a weakened esophagus may result. Achalasia should always be considered in the differential diagnosis of dysphagia.

The safest methods of treatment consist in the application of dilating procedures by the passage of the Moersch metal olive or the hydrostatic dilator of Plummer with a silk thread for a guide. A number of experimental operations have been performed, but all run the risk of mediastinitis. In all of the 8 cases of achalasia of the esophagus reported in some detail by the author, dilatation was carried out on 1 occasion only, and resulted in functional restoration of the normal swallowing mechanism in each case.

JOHN E. KIRKPATRICK, M.D.

Turner, G. G.: Non-Malignant Stenosis of the Esophagus. *Brit. J. Surg.*, 1939, 36: 555.

The greater number of cases of non-malignant stenosis of the esophagus are due to the swallowing of corrosive solutions. The condition may also follow the healing of traumas associated with foreign bodies or with attempts at their removal. Stenosis may also follow the healing of an ulcer: a peptic ulcer at the lower end of the esophagus may heal with the development of a fibrous stricture, and, similarly, the cicatrization of a high-lying gastric ulcer may leave a scar involving the lowest part of the esophagus. Other causes may be healing secondary to invasion of the esophagus by an infected mediastinal gland, inflammation spreading down along the esophagus from the pharynx, diphtheria, scarlet fever, typhoid fever, and the vomiting of pregnancy. Some cases may have their origin in a congenital narrowing of the esophagus with sclerosing changes in later life, and finally, some may be dependent upon achalasia. In the 19 cases referred to in this paper, the causation, so far as it could be ascertained, was as follows: congenital malformation, 5; corrosives, 5; late results of achalasia, 4; ulceration, 2; and acute inflammation, 1; in 2 cases it was undetermined.

The usual sites for simple strictures of the esophagus are well recognized as being at the junction of the pharynx with the esophagus, at about the crossing of the left bronchus and at the termination of the esophagus. However, such a stenosis may extend along the esophagus for a considerable distance, or there may be multiple strictures.

This is usually the question of gradually increasing dysphagia, until such time as the patient develops extreme difficulty in swallowing even water. Superadded spasm may produce variations in the severity of the symptoms.

Diagnosis is usually not difficult. Our newer methods, such as contrast x-ray examination, esophagoscopy, and biopsy, help differentiate the condition from malignant stricture.

The treatment of most strictures is largely a matter of the proper use of bougies. This should be the first and main method of treatment in all cases, whether carried out under the guidance of the eye through the esophagoscope or without its aid. Traumatism from over-dilatation or tearing must be carefully avoided. Self-dilatation by the patient may also be used. In cases in which the bougie cannot be passed, the use of the swallowed thread as a guide may be tried. A bougie must never be passed blindly under general anesthesia. Most of the patients are probably permanently cured by persistent treatment along these lines, but there is a residue of cases in which the tendency toward recurrence persists for many years and possibly throughout life.

Gastrostomy is recommended in some cases of non-malignant esophageal stricture to provide physiological rest; this permits subsidence of the local inflammation and edema preliminary to the passage of the bougies. Gastrostomy is also an essential preliminary to plastic operations involving incisions into the lumen of the esophagus.

Direct surgical attack on the strictural area is beset with many technical difficulties. The author believes that more and more effort should be exercised in attempts to restore the natural esophageal pathway rather than to remedy the disability by surgical procedures which are dangerous and difficult.

SAMUEL H. KLEIN, M.D.

Chamberlin, D. T.: Peptic Ulcer of the Esophagus. *Am. J. Digest. Dis.*, 1939, 5: 725.

In order to clarify the diagnosis of peptic ulcer of the esophagus certain diagnostic criteria are presented, in addition to an etiological factor which, according to Chamberlin, has previously been overlooked.

These criteria are:

1. The ulcer must not be associated with systemic disease. This stipulation is made because of the tendency to call any ulceration of the esophagus a "peptic ulcer," even in the presence of diabetes and

tuberculosis. The implication is not made that systemic disease affords an immunity to peptic ulcer, but in certain diseases ulceration of the mucous membranes is more than likely to be the result of the disease rather than a separate entity.

2. The ulcer must be seen at esophagoscopy or at autopsy.

3. Free hydrochloric acid must be present.

4. The ulcer must be chronic.

5. The symptoms must be relieved by peptic ulcer therapy and dilatation.

In the 7 cases described the additional etiological factor found in 6 was either a short esophagus, a diaphragmatic hernia, or both. All of the 7 patients did well on Sippy management without local treatment except dilatation, with 1 exception. This patient required phrenicectomy before relief was obtained. SAMUEL J. FOGELSON, M.D.

Hillemand, P., and Garcia-Caldéron, J.: Roentgenological Characteristics of Cancer of the Esophagus (Caractères radiologiques du cancer de l'œsophage). *Ann. méd.-chir.*, Par., 1938, 3: 325.

The roentgenological diagnosis of esophageal cancer by means of a contrast medium is not a simple problem if the lesion be an early one. The authors have worked out a technique with barium sulfate in liquid, cream, and thick paste form. With the patient standing, lying horizontally, or in the Trendelenburg position, fluoroscopic studies are made and films taken in the anteroposterior, oblique, and lateral positions. Several reproductions of x-ray studies of some of their cases attest the precision and success of their technique.

Cancer of the thoracic portion of the esophagus is found usually in the middle third. An early lesion there will cause functional disturbances, such as atony (which is shown by slow passage of the barium and filling of the piriform sinuses) and spasm, the obstructional signs of which usually first send the patient to the physician. Morphological abnormalities such as a segmental rigidity of the esophageal walls, a slight retraction of the walls in silhouette, and changes from the normal in general contour all may lead to a suspicion of a locus of cancer. However, in the early stages these signs are of but little aid in the differential diagnosis of inflammatory lesions, benign tumors, "esophagitis," or varices. The important point is that regardless of their cause and nature, these changes have been discovered, and further, more conclusive study can then be made. Cancer of the middle third in the full-blown state shows the ragged, irregular shadow with large defects and lacunæ which are unmistakable.

Early cancer of the pharyngeal orifice of the esophagus may cause points of retraction of the wall, laryngeal pressure, barium filling of the periglottal folds, and, very often, reflux of the liquid toward the nasopharynx or larynx.

If the lesion be seated at the cardia, careful distinction from cardiospasm must be made. There will usually be a ballooning of the esophagus above the lesion and a slow, irregular, non-rhythmic trickle of the fluid into the stomach. A beginning cancer at the cardia has as one of its first signs a disturbance in the function of the sphincter.

This paper is written not so much with the idea of teaching the diagnosis of esophageal cancer, as of emphasizing the need of early discovery of functional and anatomical changes which will indicate the use of endoscopy as a conclusive procedure.

JOHN MARTIN, M.D.

FACTORS IN THE PROGNOSIS AND MORTALITY OF GALL-BLADDER DISEASE

Collective Review

WARREN H. COLE, M.D., F.A.C.S., Chicago, Illinois

AN analysis of the factors involved in the prognosis and mortality of gall-bladder disease reveals the fact that numerous features of cholecystitis must be considered. Much of the data will be complicated and difficult to analyze, particularly when one attempts to summarize it or draw conclusions. A great part of the difficulty in arriving at a summation of experiences from a series of reports is dependent upon the fact that any series except a very large one presents the danger of inaccuracies because of coincidence. Perhaps equally important is the fact that variation in incidence of certain diseases or their complications may be encountered because of the geographical effect on that particular disease, even though a large series of cases is studied in each report. This is perhaps exemplified best, as will be discussed later, by the extreme variation in the incidence of carcinoma of the gall bladder associated with gall stones, as reported from various clinics.

INCIDENCE

It is agreed by all that gall-bladder disease is one of the most common diseases with which the medical profession has to cope, but it is likewise well known that it is affected very favorably by adequate therapy and the mortality is quite low. In an analysis of patients coming to a large western clinic Blackford (3) noted that 6 per cent presented complaints which were diagnosed as being produced by gall-bladder disease. This is by no means an accurate estimation of the frequency of cholecystopathy since it is a well known fact that chronic cholecystitis, with or without stones, may exist without the patient's knowledge. Of 612 routine cases which came to autopsy at the Mayo Clinic, Mentzer (23) noted that 62 per cent of the entire series, and 66 per cent of all in which the patients were more than twenty-one years of age showed gross evidence of gall-bladder disease. However, he noted that cholesterosis which was found in about 38 per cent of the entire series, occurred alone in 21 per cent of the series. Since there is a growing doubt as to the pathogenicity of cholesterosis of the gall bladder, this large group of 21 per cent would be considered by many authorities as not being comparable, from the significance of disease, to the other 41 per cent showing gall-bladder pathology. Mentzer noted that gall stones were encountered in 20 per cent of all patients, or in 21 per cent of all patients past the age of twenty-one.

In 1,000 routine autopsies in Vienna, Crump (8) found an incidence of gall-bladder disease of 59.6 per cent, and in an additional 16.5 per cent of the cases cholesterosis was present alone. Gall stones were found in 32.5 per cent of the cases, a figure still higher than Mentzer's. Mosher (24) (Baltimore) found stones in 8 per cent of a series of 1,423 autopsies of patients past the age of twenty-one; the incidence of stones in white people was 9.0 per cent and in the colored race 6.3 per cent. Stewart (27) found gall stones in 16.4 per cent of a series of 6,283 autopsies of patients past the age of forty. It would appear safe, therefore, to assume that at least 15 per cent of all people past the age of forty have gall stones, and that probably an additional 15 per cent have cholecystitis without stones (disregarding cholesterosis), but that probably less than 20 per cent of the entire group having pathological lesions will present symptoms which can be diagnosed clinically as cholecystic in origin.

It is a well known fact that cholecystic disease is much more common in women than in men. A summary of statistics from reports reviewed indicates that the ratio is fully as high as 3 to 1. In a series of 200 patients studied at our clinic at the Illinois Research Hospital the ratio of women to men was still higher, being approximately 9 to 1. This obvious inconsistency is mentioned to illustrate how misleading certain statistics may be. In this instance the explanation lies not so much perhaps in the small series as in the fact that during this period the applicants for admission exceeded the facilities for hospitalization. Patients with the most serious complaints were admitted. This statement implies that women are more apt to be afflicted with serious

From the Department of Surgery, University of Illinois, College of Medicine and the Illinois Research and Educational Hospital.

symptoms and complications than men, an observation which has in reality been made by numerous authorities. For example, the incidence of stones in the common duct as encountered at operation is much higher in women than in men, being 19 per cent and 12 per cent, respectively, in our series. This incidence which averages 18 per cent, is perhaps 1 or 2 per cent lower than the incidence reported by Lahey. To prevent the overlooking of stones in the common duct, this duct should be opened in all instances in which it is dilated or its walls are thickened, in patients who are jaundiced and in most patients who give a definite past history of jaundice. The incidence of cholelithiasis in patients operated on for gall-bladder disease will average about 50 per cent in most clinics (Heyd (18), 59 per cent, Deaver (9), 50 per cent). The disease is much less common in the Negro than in the white race.

The incidence of carcinoma of the gall bladder appears to vary considerably, and depends largely upon the source from which the statistics are drawn. Next to the immediate operative mortality following cholecystectomy for cholecystitis, the death rate incident to carcinoma of the gall bladder is probably of more significance from the standpoint of life insurance than any other disease affecting the gall bladder. Carcinoma of the gall bladder is an extremely malignant tumor, the five-year survival rate including the operative as well as the non-operative cases being considerably less than 10 per cent. The most important features of carcinoma of the gall bladder, particularly in regard to life insurance, are related, therefore, to its incidence. After a rather extensive study Rolleston and McNee (25) found that the incidence of carcinoma of the gall bladder in cholelithiasis varied between 4 and 15 per cent. The figures given in Table 1 represent those found in 11 consecutive reports encountered in a survey of the incidence of carcinoma of the gall bladder. The variation of incidence from 0.6 to 13.4 per cent is so extreme that it would appear hopeless and inaccurate to attempt to arrive at an average figure from this group of reports. When a percentage is given, specifications should be made as to the source of the cases studied, i.e., whether they were taken from autopsy or operative records, because the incidence should be lower in a group of patients who are operated upon than in a group of autopsy cases since the patients in the latter group will be older. The low incidence of 2 per cent reported by Judd and Gray (19) may in part be explained on this basis, since their figures are taken from operative cases. This is even lower than that of other reports dealing only with operative figures. There may be an additional factor of considerable importance, namely, the fact that jaundice and weakness develop insidiously without much pain in carcinoma of the gall bladder and when the patients are seen by physicians they appear too ill to travel as far as the Rochester Clinic which derives its patients largely from out of town. It scarcely appears possible to assume that the hereditary characteristics of cancer are strong enough to explain a high incidence of carcinoma of an organ in one locality and a low incidence in another, although there can be no doubt regarding the existence of "cancer families." Judd and Gray reported that of 312 cases of carcinoma of the gall bladder and bile ducts, 32 per cent occurred in the ducts.

TABLE I.—INCIDENCE OF CARCINOMA OF THE GALL BLADDER IN CHOLELITHIASIS

Author	No. of cases of cholelithiasis	No. of cases associated with carcinoma	Incidence of carcinoma (per cent)
Lentze	557	25	4.3
Heyd	330	13	4.0
Deaver and Bortz	450	13	2.9
Schroeder	141	20	13.4
Graham	564	48	8.5
Fawcett and Rippmann	592	48	8.1
Riedel	300	13	4.3
Slade	17	10	59.0
Candler	315	2	0.6
Judd and Gray	15,422	312	2.0
Illinois Research Hospital, Chicago	206	11	5.4

The relationship of gall stones to the development of carcinoma of the gall bladder has long been known. The incidence of stones in carcinoma of the gall bladder varies between 69 (Stewart, 27) and 100 per cent (Mentzer, 23). An average of 8 large series revealed an incidence of 85 per cent.

Considering the data presented, it is obvious that the incidence of carcinoma of the gall bladder in cholelithiasis is significant, and that the high incidence (85 per cent) of stones in carcinoma of the gall bladder is an important factor in its etiology. Graham (15) and others have called attention to the fact that cholecystectomy in the presence of cholelithiasis undoubtedly saves the lives of many people who otherwise would die from carcinoma of the gall bladder. It is true, however, as noted in Table 1, that the relationship

of carcinoma of the gall bladder to cholelithiasis is extremely variable. Undoubtedly the percentage would be much smaller if the survey were to include cases of cholelithiasis not confined to the hospital. Patients coming to operation for cholelithiasis would doubtlessly be older than the patients with cholelithiasis not confined to a hospital. Likewise, persons with cholelithiasis coming to autopsy would be still older. In other words, the danger of development of carcinoma of the gall bladder would in a general way increase with age and the length of time during which the individual has had the stones.

COMPLICATIONS OF CHOLECYSTITIS

The complications of cholecystitis are extremely numerous; many of them are serious. They are of extreme importance because the deaths resulting from cholecystitis, with or without operation, are for the most part caused by the *complications* and not by the disease itself. Assuming that cholelithiasis is a part of the disease, perhaps the most frequent complication is obstruction of the cystic or common duct by a stone. Usually, obstruction of this type is temporary, but not infrequently it is permanent and threatens life unless relieved. If the obstruction is in the cystic duct, hydrops or empyema will result; if in the common duct, jaundice with its manifestations will result. Suppurative cholangitis, with or without abscess formation, is a frequent complication of common-duct obstruction and is usually fatal unless corrected early in its development by drainage of the common duct. Hepatitis is a frequent accompaniment of gall-bladder disease (Graham) but fortunately is usually not serious.

Pancreatitis accompanies cholecystitis, particularly cholelithiasis, so commonly that it is considered a complication by most surgeons. Heyd (18) noted an incidence of pancreatitis (chiefly the acute edematous type) of 3.7 per cent in 557 gall-bladder operations. During the past year or two while 87 cholecystectomies for cholecystitis were being performed at the Illinois Research Hospital, 9 instances of acute pancreatitis (7 of the acute edematous type) were encountered. This constitutes an incidence of 10 per cent, which is far too high and again illustrates how great an influence the factor of coincidence may be. It is accounted for in part by the fact that the patients admitted to the Illinois Research Hospital during this period were those complaining of the most severe symptoms; but coincidence would appear to be a greater factor since in the eighteen-month period preceding this interval only 1 case was observed, and an interval of six months has elapsed since the last case was observed. The incidence of 3.7 per cent as noted by Heyd probably represents a fair average of the incidence of acute pancreatitis in gall-bladder disease. The mortality of acute edematous pancreatitis is no greater than 10 per cent, but the mortality of acute hemorrhagic pancreatitis is fully 50 per cent. Chronic pancreatitis, as indicated by a thickening of the pancreas, is diagnosed commonly at operation for gall-bladder disease, but autopsy statistics do not confirm its presence in a very high percentage of cases.

There has been a considerable difference of opinion as to the possibility of myocarditis being secondary to cholecystitis. It appears that occasionally there are instances when myocarditis is caused or aggravated by cholecystitis. Fitz-Hugh and Wolferth (13) report 6 cases of cardiac disease improved by cholecystectomy.

Bailey (1) recently analyzed 200 gall-bladder operations from the standpoint of complications and noted that complications which added seriously to the mortality of the operations required were present in 25 per cent of the cases. The incidence of serious complications is much higher in acute than in chronic cholecystitis. The serious complications of acute cholecystitis consist of perforation of the gall bladder, gangrene of the gall bladder, abscess formation, empyema, and suppurative cholangitis. Further details of the relationship of acute cholecystitis to mortality and prognosis are considered later.

THE RELATIONSHIP OF THE TYPE OF INFECTION AND THERAPEUTIC PROCEDURE TO THE RESULTS

About 8 per cent of all cases of cholecystitis encountered in hospitals are acute and present symptoms which will readily differentiate them from chronic cholecystitis. Obviously it is important whether the cholecystitis is acute or chronic, chiefly because the mortality will be greater in the former than in the latter type. The chief reason for the increased mortality rate in acute cholecystitis lies in the fact that complications are much more apt to develop in the acute cases. Many of these complications, including particularly empyema, perforation, gangrene, and suppurative cholangitis, demand operative correction, and are associated with a high mortality. The incidence of these complications varies considerably in different clinics. Judd and Phillips (20) encountered gangrene with perforation in 13.4 per cent of 508 cases of acute cholecystitis; Zinninger (28) encountered gangrene with perforation in 20.5 per cent of 78 cases of acute

cholecystitis. In the author's experience, the incidence of perforation has been lower than either of the two mentioned above.

A survey of the literature made by Heuer (17), showing a mortality of 6.6 per cent in 36,623 patients operated on for various types of gall-bladder disease (chiefly chronic), and a mortality of 8.7 per cent in 1,066 cases of acute cholecystitis, illustrates the difference in mortality of the acute and chronic cases. More important, however, is the fact that in 502 cases of gangrene of the gall bladder with perforation the mortality was 46 per cent. The high mortality with perforation of the gall bladder has led many surgeons (Zinninger, Heuer, and others) to recommend early operation in acute cholecystitis. The advantages claimed for immediate operation (cholecystectomy in most instances) in acute cholecystitis lie in the fact that during the first twenty-four or thirty-six hours the inflammatory changes in the gall bladder are so slight that cholecystectomy can be performed quite easily and without significant shock to the patient. However, surgeons recommending immediate operation for acute cholecystitis emphasize the fact that if the patient is not seen within from twenty-four to thirty-six hours following the attack it will probably be wiser to postpone the operation several days, since the inflammatory process including increased vascularity, thickening, and edema of the gall-bladder wall will have progressed so far that postponement for several days will be the safer procedure. Utilizing this rule as to operability, the mortality rate reported by the various surgeons resorting to early operation (usually cholecystectomy) for acute cholecystitis is very little if any greater than the mortality following cholecystectomy for chronic cholecystitis. However, as stated previously, there is no agreement regarding operation in acute cholecystitis. For example, Cave (5) favors delayed operation in most cases and remarks that the "majority of surgeons are obtaining better results by waiting from one to five days before operating upon patients suffering from acute cholecystitis." Obviously the abdominal signs might be so suggestive of peritonitis that operation would be indicated immediately, i.e., as soon after admission as dehydration could be corrected. Most surgeons who favor delayed operation resort to immediate operation if the fever remains prominent longer than two or three days and the manifestations of peritoneal irritation, such as tenderness and rigidity, increase in severity.

In the author's opinion, adherence to this rule in the conservative treatment of acute cholecystitis will lower the mortality rate very sharply and to a great extent will minimize the value of the principle of emergency operation for all cases of acute cholecystitis.

Although two or three decades ago cholecystostomy was perhaps preferred to cholecystectomy in the treatment of cholecystitis, practically all surgeons now agree that cholecystectomy is the procedure of choice, except in certain cases of acute cholecystitis, and in patients who are poor operative risks because of age, etc. The reason for the shift toward cholecystectomy lies in the fact that such a large percentage of patients upon whom cholecystostomy has been performed return with the recurrence of symptoms and require a second operation. For example, Black (2) noted that in his series of cholecystectomies only 1.8 per cent of his patients required an additional operation for disease of the biliary tract, whereas 24 per cent upon whom cholecystostomy had been performed required an additional operation. In 241 cases of cholecystectomy followed up by Cave (6) 86 per cent of the patients were well; in 32 patients upon whom cholecystostomy had been performed 56 per cent were operated upon a second time for persistent or recurrent symptoms referable to the biliary tract. The second operation naturally adds appreciably to the mortality, since the mortality from a secondary operation of this type (cholecystectomy in the presence of adhesions) will be higher than in an uncomplicated primary gall-bladder operation.

OPERATIVE AND NON-OPERATIVE RESULTS IN CHOLECYSTITIS, EXCLUSIVE OF MORTALITY

For a great many years there has been unanimity of opinion that surgical treatment is much more effective than medical treatment, but the operative mortality and the more than occasional persistence of symptoms following operation for gall-bladder disease remain as serious defects in surgical therapy. It is somewhat difficult to compare the results of medical and operative therapy, chiefly because very few studies have ever been made of the results of medical or non-operative therapy. The report by Blackford (3) represents one of the few available. He followed up 200 patients with cholecystitis who were not operated upon. After an interval of ten years 15 per cent were dead (at an average age of sixty-five years), but only 1 per cent died as a direct result of the gall-bladder disease. The others died from diseases such as myocarditis, nephritis, and cancer. Of the total group of 200 patients, 37 per cent were relieved or sufficiently well to be satisfied. Forty-eight per cent had poor results, inasmuch

as 21 per cent had come to operation later and 27 per cent were having so many symptoms that operation seemed definitely to be advisable. Blackford noted further that surgical emergencies arose only in 1 per cent of all cases of uncomplicated cholecystitis during the ten-year follow-up, which indicates that delay in uncomplicated cases may not be very serious.

From an analysis of the above data and other experiences it becomes obvious that the benefits to be derived from operation in cholecystitis lie chiefly in the relief of symptoms and not in its life-saving features. Since operation is not primarily a life-saving principle it is perhaps appropriate to ask ourselves if cholecystectomy is harmful in any other way besides mortality. Likewise, can the human being tolerate the absence of his gall bladder? The consensus of opinion is that the loss of the gall bladder, the functions of which are primarily to concentrate and store bile, results in no harm primarily because in most instances its functions are usually destroyed by the disease before the operation is performed. We do know, however, that cholecystectomy results in a dilatation of the bile ducts (Counseller and McIndoe) and a loss in tonus of the common-duct sphincter (Puestow). These changes, however, have not been considered detrimental. Although Eiss and Whaley (11) contend that cholecystectomy results in a greater susceptibility on the part of the bile ducts to become infected, a greater tendency toward intestinal putrefaction, and a disturbance in the digestion of fat, relief follows the operation in such a dramatic way that most authorities consider the pathological changes as being of little consequence. The above features represent practically the total of the evidence against cholecystectomy, and it is not very weighty.

The greatest source of the misfortunes following surgical treatment, outside of mortality, lies primarily in the frequency with which an error in diagnosis is made. Perhaps a more frequent cause of unfavorable results lies in the fact that the patient may have cholecystographic and pathological evidence of cholecystitis, but may be suffering from another disease, such as arthritis of the spine, spastic colitis, carcinoma of the colon, and pancreatitis, which in reality is producing the symptoms. In such an instance we should not condemn the procedure of cholecystectomy, but rather the diagnosis.

MORTALITY

The mortality following operations for gall-bladder disease in various clinics is extremely variable, partially because of coincidence alone, but especially because of the type of patients from which the figures are drawn. In other words, did the patients have uncomplicated cholecystectomies or did complicating lesions, such as suppurative cholangitis and inoperable carcinoma of the gall bladder, accompany the gall-bladder disease? The analysis of a series reported by Heyd (18) illustrates this point decisively, in so far as the mortality of 557 operations on the biliary tract (with various complications) was 7.0 per cent, but only 3.3 per cent in 500 non-complicated cholecystectomies. Heyd noted further that the mortality of all types of gall-bladder disease in 417 private cases was only 4.8 per cent, but in 140 charity patients it was 13.5 per cent. The mortality in choledochostomy for stones in the common duct will naturally be higher than the mortality of uncomplicated cholecystectomy, as is illustrated by the figure of 8.7 per cent reported by Eliason and Erb (12) and 12 per cent by Mathews (22). After reviewing the results of various surgeons I would estimate the mortality in common-duct surgery throughout the country not to be much lower than 10 per cent. As stated previously, in a survey of numerous reports in the literature, Heuer (17) found a mortality of 8 per cent in 1,066 cases of acute cholecystitis; while in 502 cases of gangrene with perforation of the gall bladder there was a mortality of 46 per cent. In his survey of 36,623 operations for gall-bladder and biliary-duct disease, he found an average mortality of 6.6 per cent. This probably represents a fairly accurate estimation of mortality when all types of patients and operations are considered.

From the above data it can readily be discerned that the mortality following gall-bladder operations varies considerably and depends upon numerous factors, one of the most important of which is the operability of the patient. Cholecystectomy for gall-bladder disease in the absence of complications, in the author's experience, is not associated with a mortality greater than 1 or 2 per cent. On the other hand, in elderly patients with myocardial or renal damage the expected mortality may be as high as 25 per cent. The age of the patient is no doubt an important factor in mortality. For example, Goldish and Gillespie (14) noted that in a series studied by them the average age of patients dying following gall-bladder operations was ten and three-tenths years more than the average age of the patients who survived the operation. Obviously, cholecystectomy should not be performed promiscuously on patients who are poor risks, but not infrequently

symptoms are so severe as to demand an operative procedure of some type. In this group of patients cholecystostomy will be much safer than cholecystectomy and may afford relief for the few years of life remaining. Although the mortality following cholecystostomy, as practiced during recent years (14 per cent in a recent series reported by Heyd), is even higher than that following cholecystectomy, the explanation can readily be found in the fact that cholecystostomy now is being performed only on the patients who are seriously ill. Even simple procedures will therefore be associated with a high mortality.

Obviously, if extreme care is exercised in estimating the operability, choosing the right time for operation, treating patients pre-operatively, and performing the type of operation most suitable for the patient, the mortality will be lowered. For example, over a three-year period Graham (16) was able to reduce his mortality in cholecystectomies from 6.0 per cent to 0.4 per cent by utilizing the precautions mentioned above and paying particular attention to the liver-function test as a means of computation of operability.

For some unexplainable reason, women tolerate gall-bladder operations much better than men. Almost invariably, in a large series, the operative mortality will be from 2 to 3 per cent higher in men than women. The mortality is usually higher in Negroes than in white people. In a series studied by Boyce and associates (4) it was found that the incidence of gall-bladder disease in Negroes was only one-fifth as great as that in white patients, but the mortality was higher, being 13.6 per cent; this was approximately 5 per cent higher than the mortality in the white patients of their series.

As intimated previously in this report, the question has been raised by many authorities as to whether the life expectancy in a patient whose gall bladder has been removed is not shortened. This question has been answered at least to some extent by Dublin and associates (10) in their analysis of a group of people insured in the Metropolitan Life Insurance Company. In the group who had had drainage of the gall bladder (cholecystostomy) the actual death rate was 155.7 per cent of the expected rate. The group which had drainage of the gall bladder for stones had a still higher death rate, namely, 214.9 per cent. In the group which was treated medically the death rate was 115.1 per cent of that expected. The lowest death rate, 95.9 per cent of the expected rate, occurred in the group of patients who had had their gall bladder removed. Although the life span in this group of people having had cholecystectomy was greater than that for the average individual, the difference was so slight that factors, such as coincidence, might explain the observation. In consideration of all the groups studied, the death rate was higher among the men than among the women. An analysis of the cause of death in the group in which the death rate was excessive revealed the remarkable fact that death was due, for the most part, to malignant or non-malignant diseases of the digestive tract. This is difficult to explain unless erroneous diagnoses and complications of gall-bladder disease could be considered factors.

An analysis of the causes of death reveals the fact that the factors responsible for death are innumerable, but more important is the lamentable fact that peritonitis is the most frequent cause of death. Probably the most extensive study made is that reported by Stanton (26) who analyzed 500 deaths following gall-bladder operations. The percentage (15.4) of deaths caused by peritonitis approaches quite closely that (16.5) reported by Colp and Ginzburg (7). In each series

TABLE II.—CAUSE OF DEATH IN GALL BLADDER OPERATIONS

	Stanton (from lit.) per cent	Colp and Ginzburg (own cases) per cent	Heuer	
			(1,000 own cases) per cent	(36,623 cases from lit.) per cent
Peritonitis	15.4	16.5	37	33
Shock	5.0			
Pneumonia	10.6	9.3	25	20
Pulmonary Embolus	6.6	2.0		
Cardiac Failure	6.8	3.1	10	12
Renal Failure	4.8	3.1		
Operative Hemorrhage	6.4	3.1		
High Temperature	4.0			
Cholemia	4.4			
Cholemia with Hemorrhage	4.0			
Hepatic Insufficiency	3.8			4
Sepsis	3.2	3.1		
Evisceration	0.2	3.1		
Suppurative Cholangitis	4.0	14.4		
Pylephlebitis		8.2		
Pancreatitis		5.2		2
Injury or Stricture C. D.		9.3		
Gangrene and Perforation			11	10
Miscellaneous			17	19

the percentage of deaths attributed to pneumonia is approximately 10 per cent.

In a much smaller series, Heyd (18) noted that approximately 20 per cent of the deaths were attributed to hepatic insufficiency. Although only 3.8 per cent of the cases studied by Stanton resulted in death due to hepatic insufficiency, it would appear that the major factor in many other groups, such as "cholemia," "cholemia with hemorrhage," "high temperature," "renal failure," and perhaps others, may be attributable to hepatic insufficiency.

Contrary to what might be expected, the incidence of evisceration as a cause of death was surprisingly low, being 0.2 per cent in one series and 3.1 per cent in the other. Maes and his associates (21) have called attention to the fact that the high incidence of death in patients who have suffered evisceration is not attributable directly to the evisceration itself. In other words, postmortem and clinical studies show quite clearly that death would have occurred anyway in the great majority of cases.

SUMMARY AND CONCLUSIONS

A statistical study of a disease as common as cholecystitis reveals the fact that variations are so great in many of the issues that an average would not appear to be accurate. However, figures regarding the incidence of cholecystitis (from the pathological standpoint) are fairly uniform. It appears safe to assume that about 15 per cent of all people past the age of forty have cholelithiasis and that an equal number have cholecystitis without stones (excluding cholesterosis which has doubtful clinical significance).

The incidence of carcinoma of the gall bladder in cholelithiasis (from 0.6 to 13.4 per cent) is so variable that the significance of a statistical average is questionable. In certain localities the incidence is high enough to be of distinct importance in determining prognosis and life expectancy. Whether huge variations are best explained on the basis of small series or because of geographical location is difficult to determine except that the latter undoubtedly is of greater importance than considered by most individuals.

There is still so much disagreement regarding the treatment of acute cholecystitis, whether it should be conservative or operative, that a decision on this point cannot be made. More accurate knowledge of the rôle of chemical versus bacterial factors in the pathogenesis of acute cholecystitis would undoubtedly help solve this problem.

The mortality of operations upon the gall bladder as computed from numerous reports appears to be about 6.5 per cent. In this group the mortality of acute cholecystitis will be as high as 8 per cent and of uncomplicated chronic cholecystitis in private practice as low as 3 per cent (contrasted to charity patients in whom the mortality is much higher). The mortality of choledochostomy throughout the country is probably no less than 10 per cent.

The most common causes of death in gall-bladder surgery are peritonitis, pulmonary complications, and hepatic insufficiency.

BIBLIOGRAPHY

1. Bailey, F. W. Ann. Surg., 1936, 103: 781.
2. Black, J. M. Brit. M. J., 1935, 1: 11.
3. Blackford, J. M. Tr. Am. Gastro-Enterol. Ass., 1933, 36: 344.
4. Boyce, Veal, and McFetridge. Surg., Gynec. & Obst., 1926, 63: 43.
5. Cave, H. W. Surg., Gynec. & Obst., 1938, 66: 308.
6. Idem. Ann. Surg., 1926, 84: 371.
7. Colp, R., and Ginzburg, L. Ann. Surg., 1937, 105: 9.
8. Crump, C. Surg., Gynec. & Obst., 1931, 53: 447.
9. Deaver, J. B., and Bortz, E. L. J. Am. M. Ass., 1927, 88: 619.
10. Dublin, L. I., Jimenis, A. O., and Marks, H. H. Proc. Ass. Life Insur. M. Dir. America, 1934, 21: 34.
11. Eiss, S., and Whaley, J. H. Ann. Surg., 1935, 101: 921.
12. Eliason, E. L., and Erb, W. Ann. Surg., 1935, 101: 460.
13. Fitz-Hugh, T., and Wolferth, C. C. Ann. Surg., 1935, 101: 478.
14. Goldish, D. R., and Gillespie, M. G. Am. J. Surg., 1933, 21: 37.
15. Graham, E. A. Ann. Surg., 1931, 93: 317.
16. Idem. Illinois M. J., 1931, 60: 196.
17. Heuer, G. Ann. Surg., 1934, 99: 881.
18. Heyd, C. G. Ann. Surg., 1937, 105: 1.
19. Judd, E. S., and Gray, H. K. Surg., Gynec. & Obst., 1932, 55: 308.
20. Judd, E. S., and Phillips, J. R. Tr. Am. Surg. Ass., 1933, 51: 292.
21. Maes, H., Boyce, F. F., and McFetridge, E. M. Ann. Surg., 1934, 100: 968.
22. Mathews, F. S. Proc. Ass. Life Insur. M. Dir. America, 1925, 13: 139.
23. Mentzer, S. H. Surg., Gynec. & Obst., 1926, 42: 782.
24. Mosher, C. D. Abstract in: Johns Hopkins Hosp. Bull., 1901, 12: 253.
25. Rolleston, Sir H., and McNee, J. W. Diseases of the Liver, Gall Bladder and Bile Ducts. London: Macmillan & Co., 1929.
26. Stanton, E. M. Am. J. Surg., 1930, 8: 1026.
27. Stewart, M. J. Lancet, 1937, 2: 617.
28. Zinninger, M. Ann. Surg., 1932, 96: 406.

ABDOMINAL WALL AND PERITONEUM

Pilcher, R.: The Repair of Hernia with Plantaris-Tendon Grafts. *Arch. Surg.*, 1939, 38: 16.

The plantaris tendon is a suitable structure for grafting and can be used in operations usually performed with grafts of fascia lata, over which it has several advantages.

It is absent in 7.5 per cent of subjects. In a further proportion of cases it is too slender to be used as a graft in hernia repair, although it may be adequate for other purposes as a suture material. This constitutes the sole disadvantage of the proposed use of the tendon. The deficiency, however, is more common in women than in men, and it is for the latter that the graft is mostly required for hernia repair. Moreover, the tendon is often palpable through the skin, and, although its absence cannot be inferred when it is impalpable, it is often possible to determine that it is present and well developed before an operation is begun.

For the greater part of its course the tendon lies in loose areolar tissue; this allows easy separation by blunt dissection; but where it passes under the edge of the gastrocnemius muscle it may be held close between that muscle and the soleus tendon, and a little difficulty may be encountered in separating it from them.

The tendon has the curious property of stretching laterally without splitting. Even a slender specimen may be pulled out easily into a sheet 2 in. wide. A part of this lateral stretching occurs at the expense of the length, and if the stretched tendon is pulled lengthwise, it resumes its cordlike form. Use is made of this property in the method of repair of hernia described.

An incision 1 in. (2.5 cm.) long is made over the medial aspect of the Achilles tendon a little above its lower end. If the tendon is in its most common place it will be exposed by the incision and will be seen lying on the Achilles tendon. If not present here it should be sought in the fat anteromedial to the tendon, where it is easily identified if made taut by dorsiflexion of the foot. Finally, it may sometimes be found closely applied to the anterior aspect of the Achilles tendon. When found it is cleaned in the length of the wound and divided as low as possible. The cut end is then passed through the eye of the stripper (Fig. 1), which is the only special instrument required and is a modification of Mayo's varicose-vein enucleator. The eye of the stripper, threaded over the tendon, is then inserted in the wound and pushed up the leg while tension is maintained on the cut end. Very little resistance is encountered to the passage of the stripper, but it may require a little coaxing about the middle of the tendon, where it lies in the angle at the junction of the gastrocnemius and soleus tendons. The stripper is pushed up until the eye lies just below the popliteal fossa. A second incision, 1 in. long, is now made over the medial edge of the tibia, near its upper end where it expands toward its head. This

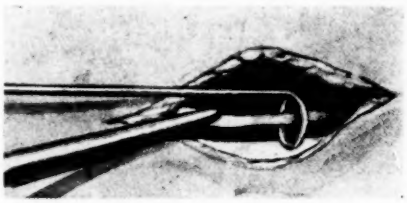

Fig. 1. Plantaris tendon exposed at the lower end, divided and threaded through the eye of the stripper.

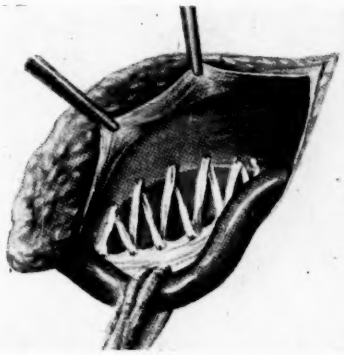

Fig. 2 Graft stitched in position before spreading of the strands.

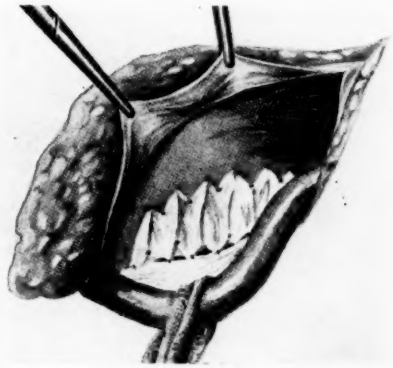

Fig. 3. Adjacent strands of graft spread and sutured to one another.

incision is carried through the deep fascia, which is a forward extension of that enclosing the gastrocnemius muscle. The incision in the deep fascia opens the plane between the gastrocnemius and the soleus muscles. The muscles are separated by blunt dissection and held apart with the blades of a large artery forceps. The assistant by manipulating the handle of the stripper can direct its eye toward the surface of the wound, the tendon at this level being deep because of its oblique course toward the lateral condyle of the femur. The tendon is easily identified in the eye of the stripper and is divided as high as possible. Tendon and stripper are then withdrawn through the lower incision, and both incisions are closed. No vessels of any size need be divided by the incisions, the subcutaneous veins in the upper part being usually visible and easy to avoid. At first the upper incision was made on the eye of the stripper while the assistant directed it to the surface, but this method was abandoned as it was feared the saphenous nerve might be injured. Because of the possibility of bleeding from the binding of vessels crossing the lower half of the tendon, a crepe bandage is applied to the leg.

The tendon is used as a graft and not as a suture. It is hoped that the tendon will be less readily absorbed than fascia lata, but as yet there is no evidence on this point. On the assumption, however, that absorption may occur, the graft is fixed in position with unabsorbable sutures of thread or silk which, acting as foreign bodies, stimulate fibrous tissue which is permanent. Fibrosis stimulated by absorbable agents is not permanent, as can be seen in the treatment of hernia by injection.

After the usual treatment of the sac, the inguinal canal is prepared for the graft. In the case of direct hernia the defect in the transversalis fascia is closed with silk or thread. The inguinal ligament and conjoined tendon are cleared of areolar tissue. As far as possible the graft is fixed to aponeurotic rather than muscular structures, and when the internal oblique is muscular it may be better to use the underlying transversalis aponeurosis. Rarely do the muscular fibers of the transversalis extend as low as the spermatic cord. The graft is fixed in a zigzag pattern, being sutured alternately to the inguinal ligament and the conjoined tendon or one of its components with fine silk or thread (Fig. 2). Care must be taken that the medial angle is adequately covered. There is no tension on the graft, and no attempt is made to approximate the conjoined tendon to the inguinal ligament. The outer end of the graft may be fixed in a loop around the internal ring. After the graft has been fixed in the zigzag fashion, adjacent strands are sutured to one another, the property of lateral stretching allowing this to be done without tension (Fig. 3). In this way the grid of tendon strips is converted into the equivalent of a continuous fascial sheet. The cord is replaced and the wound closed in layers.

The advantages claimed for the method are as follows: The structure used as a graft is removed with very little trauma, and its removal causes no disability. Being tendinous, the graft is probably less easily absorbed than fascia. The graft is inserted with minimal trauma to the structures between which it acts as a bridge. It is fixed without tension with unabsorbable sutures; this excites fibrosis which persists even if the graft is absorbed. Lateral stretching of the graft makes approximation of adjacent strands possible without tension.

SAMUEL KAHN, M.D.

Leibovici, R., and Yovanovitch, B. Y.: Encapsulating Peritonitis; Etiology, Diagnosis, and Treatment (Quelques remarques sur la péritonite encapsulante. Étiologie, diagnostic et traitement). *Rev. de chir.*, Par., 1938, 57: 734.

In 1931 Wilmoth and Patel drew attention to a special form of chronic plastic peritonitis, characterized by the encystment of a portion of the intestine in a fibroserous sac, and called "encapsulating peritonitis." This was no new entity; it had been described previously by several German surgeons. Leibovici and Yovanovitch have had occasion to review a series of 62 such cases, as well as to have personal experience in the diagnosis and treatment of 6 cases. Their ideas relative to etiology, diagnosis, and treatment do not slavishly follow the prescribed rules; rather, they have formed certain new concepts which would appear to be well grounded.

In spite of all the minute details of anatomical characteristics and variation described for this lesion, the authors believe that its sole reliable characteristic is the presence of an encapsulated mass containing all or a part of the intestine. The exact fibrous or serous, reddish or blanched, tough or delicate nature, or its adherent or loose fixation to the parietal peritoneum are not held by the authors to be important factors.

Various theories have been propounded concerning the cause of these lesions. Gastric hypo-acidity, congenital malformation, a constitutional tendency toward fibrous-tissue formation, previous operative trauma, accidental trauma, colitis, chronic appendicitis, adnexal disease, "internal hernia," acute peritonitis, and syphilis have all been proposed as the etiological basis for encapsulating peritonitis. However, the authors are satisfied in their own minds that the actual cause in all proved cases is tuberculosis. In this belief, they will no doubt find considerable support from other present-day surgeons.

They find peritoneal or pulmonary tuberculosis existing in almost every case of encapsulating peritonitis. The diagnosis need not be considered as too complex a task. In a patient who has had ascites or other tuberculous pleuroperitoneal antecedents, who has in the recent past shown signs of subtotal intestinal occlusion, and who upon examination presents a soft or flabby palpable mass, encapsulating peritonitis of tuberculous origin must be considered first of all.

The authors are inclined to be conservative in their treatment. They prefer not to attempt removal of the mass unless it is "cold" or in a state of chronic quiescence. In such a case, if a bowel obstruction is present or threatening, they may attempt careful dissection with freeing of the bowel, followed by irradiation of the opened peritoneal cavity. In any other case, treatment is limited to irradiation, especially if there is any reason to believe that the mass is actively inflammatory. With this "hands off" policy, their results have been good.

JOHN MARTIN, M.D.

GASTRO-INTESTINAL TRACT

Dobbs, R. H.: The Treatment of Pyloric Stenosis with Eumydrin. *Lancet*, 1939, 236: 12.

Twenty cases of pyloric stenosis in infants were treated with eumydrin (atropine methylnitrate). The drug was prepared in a solution of 1 to 10,000 and the dosage was 1 c.cm., which was increased to from 4 to 6 c.cm. and given twenty minutes before feeding. Dehydration and alkalosis were combated by the usual injections of normal saline solution and food was withheld for from twelve to eighteen hours at the onset of the treatment. Breast milk was preferred; the feedings began with 8 c.cm. every two hours and increased to normal feedings after three or four days. Before the treatment, gastric lavage was carried out daily until there was no evidence of gastric retention. The drug was usually continued over a period of from six to twelve weeks. In only 1 infant, receiving 8 c.cm. before each feeding, was there a development of symptoms similar to atropin poisoning. Sixteen of the 20 patients were cured by this treatment. Three patients were operated upon successfully after administration of the drug had failed to relieve the vomiting, and 1 patient died while undergoing medical treatment.

ROBERT ZOLLINGER, M.D.

Loewy, G.: Five Cases of Gastrojejunocolic Fistula. The Two-Stage Operation. The Surgical Technique (A propos de 5 observations de fistules gastro-jéjuno-coliques. Opération en deux temps. Technique chirurgicale). *J. de chir.*, 1939, 53: 30.

As many surgeons know, a gastrojejunocolic fistula may be the unfortunate sequence to a gastroenterostomy, performed with or without pylorectomy or other additional surgical procedures, in the treatment of peptic ulcer. The complexity of such a fistula, the fecal contamination of the stomach and jejunum, the stenosis of the large bowel, and the weakened condition of the patient all are factors which combine to make surgical correction one of the most redoubtable operations in all surgery. Loewy has had occasion to operate upon 5 patients with such a lesion, during the past five years.

The author believes that except in rare cases, the surgeon should prepare the patient for two separate operations. First, just as soon as there is clinical evidence of the existence of such a fistula, a careful and painstaking dissection of the fistula must be made, with excision of its openings into the stomach, jejunum, and colon, followed by careful closure of these openings. Then every supportive care should be given to the patient for at least four weeks before the final operation is to be attempted. This consists of partial or subtotal removal of the stomach, with a fresh gastrojejunostomy in a now clean, uncontaminated field, for the cure of the original lesion, the peptic ulcer. To repair the fistula and perform a gastrectomy all in one stage is courting disaster and it must not be considered unless one's hand is forced.

Loewy uses a combination of spinal anesthesia and sympathetic block. He warns especially against damage to the blood vessels in the dissection of the fistula, and regards this first operation as the one requiring the greatest amount of skill, precision, and methodical treatment. Most patients surviving the repair of the fistula from twenty-four to forty-eight hours withstand the subsequent gastrectomy well, and once safely through the first operation they may be expected to attain eventual cure.

JOHN MARTIN, M.D.

Stotz, W.: Gastric Phlegmon (Ueber die Magenphlegmone). *Arch. f. klin. Chir.*, 1938, 192: 134.

The author gives a good picture of the present day conception of gastric phlegmon.

Gastric phlegmon is very rare. Three hundred and one cases have been reported, of which 105 have been collected by the author since the compilation of Finsterer ten years ago. This includes the 84 cases described by Melander.

The author groups these phlegmons according to the classification of Stindberg as follows: (1) the gastric phlegmon which is either diffuse or circumscribed; (2) the gastric abscess; (3) the mixed forms, (a) with one or more abscesses and (b) with more or less phlegmon.

The pathology is usually first limited to the submucosa, from which the muscularis is invaded, and seldom involves the mucous membrane. Following perforation into the gastric lumen the abscess may drain from below the submucosa. The extent of the process can be determined only histologically even though macroscopically the transition from pathological to normal is very noticeable. A chronic case of phlegmon may proceed to linitis. Streptococci were found in 79 per cent, pneumococci in 4 per cent, and Fraenkel-Welch bacilli in 1 per cent.

The primary idiopathic disease is believed to be caused by other factors, however. The earlier belief that poor hygienic factors (alcoholism) caused the condition is not correct. Racial characteristics may have some bearing: the condition is found very frequently in the Ukraine. Men are affected more often than women. The patients were most often between the third and sixth decades of life. There are two forms of gastric phlegmon: (1) the acute, with fever and general symptoms predominating; and (2) the subacute, a chronic form usually without

fever. The symptoms are usually referred to the upper abdomen. Pre-operative diagnosis was possible in only 2 of the 66 cases seen in the last ten years. Two cases have been reported in which such a pre-operative diagnosis was made roentgenologically (Rothermel and Olsson).

The prognosis is bad; Sundberg reports a mortality of 92 per cent. In the author's 105 cases the mortality was 70 per cent. The prognosis is best in the chronic localized cases. The more severe the peritonitis accompanying the condition, the poorer the prognosis.

The treatment is essentially surgical. Of 30 patients treated by gastric resection, 21 survived; all of this group presented the subacute chronic localized type of phlegmon. Only 1 patient with diffuse gastric phlegmon (reported by Melander) who underwent exploratory laparotomy and was treated with antistreptococcic serum and drainage, and an additional patient (case reported by von Paugger), also undergoing laparotomy and treated by omental covering of the necrotic gastric wall plus drainage of the peritoneal cavity, have recovered. However, resection is not always the operation of choice; the surgeon must rely entirely upon the findings in each specific case. At present, treatment with prontosil should be considered. The author reports 2 cases of his own. Both patients died, one after operation, the other after exploratory laparotomy.

(Franz). Samuel J. Fogelson, M.D.

Salaris, C.: Benign Tumors of the Stomach and Duodenum. A Clinical and Anatomicopathological Contribution (I tumori benigni dello stomaco e del duodeno. Contributo clinico e anatomo patologico). *Arch. ital. d. mal. dell'appar. digerente*, 1938, 7: 499.

Benign tumors of the stomach may belong to various histological types according to the tissue from which they originate; the most common are the adenomas and myomas, and the rarest the lipomas and tumors of vascular type. They are sessile or pedunculated, being called polyps in the latter case. Benign tumors of the duodenum occur only rarely as isolated formations, but more frequently as duodenal polyposis associated with gastric and rectal polyposis; they are usually of adenomatous or connective-tissue type and are nearly always found in the first part of the duodenum.

The relative frequency of these benign tumors amounts to 6.9 per thousand of that of the malignant tumors. The clinical symptomatology is very indefinite, but the roentgenologist usually succeeds in solving various difficulties arising in the interpretation of a gastric tumor by the use of the current technical refinements. Generally, the form of the stomach is preserved, its walls appear normal, and active and passive movements are not altered; this also excludes infiltration of the ligaments and mesentery. However, in tumors with intraparietal development, suspicion of a filling defect of cancerous or inflammatory type may arise at first sight, but careful examination will show that the lacuna is well rounded, with distinct borders, similar to that found in compression by extrinsic organs; changes in the position of the patient allow differential study. These roentgenological findings apply also to benign tumors of the duodenum, but examination of the first portion of the duodenum is easier than that of the other two portions. A lacunar defect in the bulb calls for further study, and possible sources of error, such as the presence of foreign bodies and bulbar ulcer with hypertrophic and distinct margins, must be kept in mind.

The complications of benign tumors are hemorrhage, leading gradually to anemia, especially of hyperchromic type with marked hypochlorhydria and even complete achlorhydria; occlusion of the pylorus by a pedunculated tumor; gastroduodenal invagination; and the possibility of malignant degeneration. The association of malignant and benign tumors in the stomach has been reported. A purely clinical diagnosis of benign tumor is nearly impossible; the prognosis must necessarily be reserved; and treatment in case of certain or probable diagnosis must be surgical.

Salaris describes several cases of benign tumor of the stomach and of the duodenum. Correct clinical diagnosis was made in 4; while a malignant tumor was believed present in 2, and hemorrhage from duodenal ulcer was diagnosed in 1. The 3 diagnostic errors were due to the impossibility of making the necessary complete investigation of the patients on account of the gravity of their condition on admission. In 1 of the correctly diagnosed cases, duodenal polyposis had escaped observation because of the preponderance of the gastric symptoms, and was discovered at necropsy. The 4 correctly diagnosed cases included hypertrophic gastritis with polyp formation, gastric polyposis, polyp of the angulus, and polyp of the duodenal bulb. In 2 of the 5 cases of benign gastric tumor there was complete gastric achylia with the blood findings of typical pernicious anemia demonstrated in the peripheral blood and in the sternal bone marrow; this association can hardly be fortuitous in view of the rarity of benign gastric tumors and the relative frequency of pernicious anemia. Richard Kemel, M.D.

Finsterer, H.: Malignant Degeneration of Gastric Ulcer. *Proc. Roy. Soc. Med.*, Lond., 1939, 32: 183.

Malignant degeneration of a gastric ulcer is a much more serious complication than either acute perforation or acute profuse hemorrhage because it may not only end fatally from the surgical intervention, but also through the frequent subsequent development of metastases after a radical operation. It is never possible to establish definitely how often a gastric ulcer undergoes malignant degeneration because this would require knowing in a given country the clinical picture of ulcer-cancer, and also following up all these patients for life. For this reason it is only possible to approximate the percentage of malignant changes in gastric lesions.

Post-mortem examination is the least satisfactory method to establish the incidence of ulcer-cancer because after the patient has died from an ulcer-cancer the malignant growth usually has so completely overgrown the ulcer that it can no longer be recognized as ulcer-cancer. However, should the patient die from another cause it would be possible to recognize from the post-mortem specimens an accidental finding of ulcer-cancer. Examination of the operative specimen is of much greater value in the recognition of early degeneration. The wide difference reported (5 to 50 per cent) may be explained by variation in the type of patients operated upon as well as variation in the thoroughness of histological study. The surgeon who refuses to operate upon acute flat ulcers, limiting his material to chronic ulcers of long standing and resecting all gastric ulcers, even those near the pylorus and penetrating into the pancreas, which are often dismissed with only a gastro-enterostomy, will have a higher incidence of malignant degeneration than the one who operates on acute ulcer, or resects the small flat ulcers which rarely degenerate, and leaves the calloused lesions penetrating into the pancreas.

Histological examination requires an experienced pathologist because it is exceedingly difficult to differentiate early malignancy from the heterotypical epithelial proliferation at the edge of a healing ulcer. This requires years of experience. Again it is occasionally extremely difficult to find the area of malignant degeneration because this would require serial section examination of each ulcer. Moreover, there are cases in which thorough examination failed to reveal cancer but the patient subsequently died from metastases in the liver although no gastric malignancy could be found at post mortem.

Konjetzny is quoted as maintaining that Finsterer's high percentage (24) of malignant degeneration is due to the fact that (1) ulcerated primary cancer was diagnosed as degenerated ulcer; and (2) cases with atypical epithelial proliferation of a healing ulcer were diagnosed histologically as early cancer. In answer to this criticism, Finsterer points out that his pathologists, Stoerk, Baur, Chirari, Maresch, and Sternberg, all competent gastric histologists, have made the diagnoses in his material. Moreover, the ultimate death of several of his patients with metastases in the liver have proved the accuracy of the diagnosis made by these pathologists.

The author has grouped his 141 personal cases of ulcer-cancer into three groups. Group I consisted of 41 cases diagnosed clinically and at operation as ulcer, but which upon histological examination showed incipient cancer. Thirty-five of the patients were operated upon before 1933 and 18 (51.4 per cent) have been symptom-free for more than five years. Group II consisted of 55 clinically diagnosed cases of ulcer in which the diagnosis of ulcer-cancer was made during the operation and subsequently confirmed histologically. Twenty-seven of the patients were operated upon before 1933 and only 4 of these (14.8 per cent) are still symptom-free. Group III consisted of 45 cases diagnosed both clinically and macroscopically as ulcer-cancer. Thirty-seven of the patients were operated upon and only 2 (5.4 per cent) have been symptom-free for the same period. In addition, Finsterer found that in his series of 532 resections for gastric ulcer the frequency of ulcer-cancer was 20.9 per cent. In another series of 718 resections for gastric cancer the frequency of ulcer-cancer was 19.6 per cent. Therefore, early surgery is justified in all these patients because the surgical mortality for gastric resection, without attack upon the pancreas, liver, and colon, in the 99 patients operated upon in Groups I, II, and III was 4 per cent. SAMUEL J. FOGELSON, M.D.

Grauhan, M.: Age and Resection of Carcinoma of the Stomach (Alter und Resektion des Magenkrebses). *Ztschr. f. Alterforsch.*, 1938, 1: 49.

During the course of eight years, from January 1, 1929, to December 31, 1936, 149 cases of carcinoma of the stomach which showed subsequent typical courses, i.e., death occurred within two years, were found by clinical and x-ray examination. The youngest patient was twenty-six years and the oldest seventy-two. Six (4 per cent) had not yet reached the age of thirty. Ten per cent were more than seventy years old. More than half were between sixty and seventy years of age. An abrupt rise in the curve of incidence occurs at the forty-fifth year. After this age is reached the radical operation cannot be performed as frequently as before and the mortality for resection rises. As the outlook is absolutely hopeless when a resection cannot be done (81 per cent of the inoperable cases terminated fatally within one-half year and only 3 of the patients survived more than one year) the operation frequently has to be done even if the prognosis is poor. Of the 54 patients who were less than fifty-five years of age, 75 per cent were operated upon; while of the 95 patients more than fifty-five years old, only 45 per cent came to operation.

Grauhan had much more success in the cases of total resection in which the duodenum was joined with the esophagus, than when he performed a subtotal operation, after which all of the patients died. In 68 per cent of the patients who were less than fifty-five years of age and came to operation, resection could be performed, while only 54 per cent of those more than fifty-five years old could be treated similarly. Thirty-seven per cent of all patients who underwent resection died within the first four weeks after operation. The mortality among the 28 patients who were less than fifty-five years of age was 25 per cent; of the 63 upon whom resection was done after the fifty-fifth year, 52 per cent died.

Unfortunately recurrences occurred after a longer time had elapsed. Grauhan refers to the case of a woman who was able to carry on her normal activities and was free from symptoms for a period of seven years, after which time she developed a recurrence in the form of a large intraperitoneal tumor. (BERGEMANN). JOHN A. GIUS, M.D.

Dill, L. V., and Isenhour, C. E.: Observations on the Incidence and Cause of Fever in Patients with Bleeding Peptic Ulcer. *Am. J. Digest. Dis.*, 1939, 5: 779.

Despite their failure to determine the cause of fever in patients with bleeding peptic ulcer, the essayists present in this study a combination of clinical and experimental investigations which should stimulate further research on this subject. No one to date has adequately explained the cause of fever following hemorrhage from ulcer. In general, the presence of blood in the gastro-intestinal tract has been considered the most significant causative factor.

From 1925 through 1936 there were 199 patients with proved peptic ulcer admitted to the Vanderbilt Hospital. They were classified in three groups. Group I consisted of 155 patients with peptic ulcer whose stools showed no occult blood and who presented no history of recent bleeding. Group II consisted of the remaining 44 ulcer patients whose stools gave strong reactions for occult blood and who, for the most part, had come into the hospital for complaints referable to hemorrhage. There was, in addition, a control group (Group III), which consisted of 78 patients in whom no organic disease of the gastro-intestinal tract could be demonstrated and in whom the diagnosis of gastric neurosis was subsequently made.

In this study fever was arbitrarily defined as any rise in temperature above 99 degrees F. which persisted for more than two days; any rise to 99.2 degrees F. or above for two days; or any single rise exceeding 100 degrees F. One hundred and six of the 199 patients, or 53 per cent, had fever which satisfied the criteria established. Forty-six per cent, or 71, of the 155 patients with non-bleeding ulcer had fever. Thirty-five of the 44 patients with bleeding ulcer, or 80 per cent, were febrile. Fever was present also in 37 per cent of the patients with gastric neurosis. This observation would suggest that hemorrhage or blood in the gastro-intestinal tract was a significant causative factor.

However, the study was further supplemented with valuable experimental studies. In dogs bled approximately one-fourth of their blood volume there was practically no elevation in temperature. In dogs bled one-fourth of their blood volume and then fed this same blood by stomach tube, there was no significant fever elevation. The study was thereafter supplemented by human experiments in which more than 500 c.cm. of human blood were given by stomach tube. None of these patients showed an elevation of temperature.

From this material the authors conclude that elevation in temperature occurs more frequently in patients with bleeding ulcer than in those with ulcer and no hemorrhage, but their experimental work does not clarify the causative factors concerned. It does suggest, however, that blood in the gastro-intestinal tract is not the sole causative factor.

SAMUEL J. FOGELSON, M.D.

St. John, F. B., Harvey, H. D., Gius, J. A., and Goodman, E. N.: A Study of the Results of Surgical Treatment of Peptic Ulcer. *Ann. Surg.*, 1939, 109: 193.

In the year 1916, the surgical department of the Presbyterian Hospital, New York, organized a follow-up clinic for the purpose of recording and studying the results of their surgical therapy in gastroduodenal ulcerative disease. From the data accumulated in the past twenty-two years, the essayists reached certain conclusions which they present.

First, they learned that every case must be followed in continuity. In order to do this, graph records were prepared, to enable the examining physician to follow at a glance the course of the case. These charts, which appear in the article, are a most practical, as well as efficient, method of obtaining statistical data on patients with ulcer. In addition, a standard for recording the follow-up results was prepared. The results were evaluated from an anatomical, symptomatic, and economic standpoint. Symptomatic results were the only ones considered in the article.

Four main groups were subdivided as follows:

Groups 1 and 2 included cases in which the results were unsatisfactory. Groups 3 and 4 included cases in which satisfactory results were obtained. Group 3 included the cases of only those patients having no significant symptoms and in whom "only the mild digestive disturbances to which normal man is heir" may occur. Group 1 contained those cases in which the results were the least satisfactory of all. If at any time a given case presented unsatisfactory results, it was permanently dropped from the groups with satisfactory results. By a critical appraisal of their follow-up records, it was hoped that it would be possible to establish with reasonable accuracy standards of guidance in the selection of cases for operation, as well as in the choice of operation to be employed for individual cases. In addition, the patients were catalogued according to the outstanding pre-operative complaints, such as obstruction, bleeding, and pain, with the appreciation that such a separation of cases into these three groups could never be wholly accurate.

From this study it was found, in the obstruction group alone, that partial gastrectomy gave no better results than gastro-enterostomy, and the death rate for the latter was lower. The Finney type of pyloroplasty gave the least desirable results in the cases of patients complaining of obstruction alone.

Seven of the 281 patients studied died of their ulcer at some time after leaving the hospital. In addition, 2 died of pulmonary lesions and 20 died of miscellaneous other causes. Partial gastrectomy of the Billroth and Polya types was found most successful for gastric ulcers, as it gave satisfactory results in 92 per cent of the cases. It was found also that the duration of the observation period was most important and that "a distressing number of initial recurrences of symptoms occurred many years after

operation." Of the 29 patients who were free from symptoms for ten years after gastro-enterostomy, 5 had recurrences later, i.e., before fifteen years.

An attempt was made to analyze the causes of failure following those operations which were performed most frequently. In a total of 314 individuals, the condition of 118 became unsatisfactory sooner or later, temporarily at least. Recurring marginal or jejunal ulcers, demonstrated roentgenologically, appeared in about one-half the patients upon whom unsuccessful gastro-enterostomy had been performed, as well as in one-half of those who had undergone unsuccessful partial gastrectomy. Poorly functioning stomas appeared relatively more frequently among the patients upon whom gastro-enterostomy had been performed.

An attempt was made to learn how often carcinoma developed in previously benign ulcers, but a conclusion was not reached in this study. Of 88 patients with gastric ulcer, 3 died of carcinoma, without recognition of the disease at the time the symptoms first developed. The good results that have followed partial resection for benign ulcers have encouraged resection more than ever in the cases of doubtful conditions which do not heal rapidly under medical care. The mortality rate in the cases of 133 patients who had undergone partial gastrectomy was 16.5 per cent. Death from duodenal ulcer occurred in 18.5 per cent of the cases, and from gastric ulcer in 13 per cent of the cases.

Leakage in the suture line was found to have caused somewhere between 37.5 and 68.8 per cent of all deaths. Obstruction was of even greater importance because it was known to have occurred in 9 of 16 fatalities, and may possibly have been present in 5 other cases. Obstruction was believed to be caused by the kinking or twisting occurring close to the site of the anastomosis in either the proximal or distal loop. Four of 6 leaking duodenal stumps were associated with, or probably partly caused by, such obstructions. A drain placed in the site of the stump almost as a routine measure should suffice for the leaking duodenal stump. Not one of the surgeons who operated in the 8 cases in which such leakage occurred thought his closure of the stump was insecure; otherwise drainage would have been instituted. Inasmuch as it is impossible to predict which stump will yield to the pressure caused by the unexpected obstruction which may or may not be temporary, drainage is recommended. The fistulas which have developed in this series have all closed spontaneously.

It was of interest to note that there was little preference between the anterior and posterior Polya technique, from a standpoint of postoperative mortality, or incidence of postoperative complications and follow-up results.

The conclusion is drawn that until the cause of peptic ulcer is known, efforts should be directed, not toward more radical surgery as is the present trend, but rather toward selective surgery. This selection can be made only if follow-up results are known and, as surgeons, it is our responsibility to select the patient for the operation and the operation for the patient. SAMUEL J. FOGELSON, M.D.

Yódice, A., and Giordano, A.: Semilunar Ganglionectomy and Constipation (Semilunectomía y constipación). *Arch. argent. de enferm. d. apar. digest.*, 1939, 14: 208.

In a memorable work, Bayliss and Starling, in 1899, demonstrated that intestinal peristalsis consists of a wave of relaxation followed immediately by a second wave of contraction. This peristalsis is a universal phenomenon in all of the enteric tract, but the waves, generally speaking, are very frequent in the duodenum and infrequent in the colon. If all the waves which begin in the higher portion of the tract continued to the anus, the evacuation would be rhythmical and too frequent; every two or three hours there would be elimination of a small quantity of feces. This, however, is not true in the normal organism; in the latter the peristalsis diminishes gradually and reaches its minimum in the last portion of the colon. The delay transforms what would otherwise be a continuous passage of feces through the anus, to elimination once or twice daily.

It has been shown that the extrinsic innervation of the intestine brings the inhibitory stimulus, and the section of some of these nerves cures or improves the constipation. The best demonstration was made by Trumble of Melbourne, Australia (Brit. J. Surg., Vol. 13), who sectioned the inferior splanchnic nerves in dogs and monkeys, with the immediate release of the intestinal contents and the appearance of powerful intestinal waves. The section of the splanchnic nerve in 2 patients with constipation brought the same effect but with some attenuation.

Further experiments with excitation of the pelvic nerve, sometimes with previous destruction of the brain or the medulla, or with section of the splanchnic or the hypogastric nerve, were registered at various heights of the bowel with enterographs.

Pieri divides the constipation into right or atonic, left or spastic. In the right constipation he resects the lumbal ganglions transperitoneally. In this way he can resect the left and right chains in one sitting. He admits that in atonic constipation the results are not as good as in Hirschsprung's disease. In the latter he also resects the ileocolic plexus.

In the spastic, painful, or left constipation, he resects the inferior mesenteric plexus around the mesenteric vessels. He gets good results or aggravations of the condition.

He warns against the resection of the hypogastric plexus which is innocuous in the woman, but can be dangerous in the man, as this is the way for the ejaculation reflex.

The author had a case of left, painful constipation, rebellious to all previous forms of treatment. Upon request of the patient who asked for some relief, and with all the theoretical knowledge gathered from the literature, he decided to perform a left semilunar ganglionectomy.

The patient had not evacuated sometimes for up to fifteen days in spite of the administration of cathartics daily. The clinical and radiological findings failed to demonstrate any organic reason. The rectum was examined with the rectoscope for 30 cm., and the feces were normal.

The operation was performed under peridural anesthesia. A lateral incision, like the Israel incision for nephrectomy was made. The muscular layers were retracted through the triangle of Petit, with the technique described by Eckvorn. The left splanchnic nerve coming out between the crus mediale and the crus intermedium of the diaphragm was investigated.

Section of the left splanchnic nerve was followed by semilunar ganglionectomy. The wound was sutured with catgut.

The examination of the specimen taken in the operation showed a sympathetic ganglion.

Three days after the operation the patient felt intense heat in the zone of the wound and the left leg, which increased with purgatives and brought relief.

On the sixth day there was a spontaneous evacuation of the bowels, and on the seventh day another evacuation, without pain in the abdomen.

The x-rays after thirty days showed no changes, but the patient relieved his bowels daily without laxatives, had no pains, reported an increase of 7 kgm. of weight, and felt very well.

The author hopes that new cases will show the real value of this procedure and the correctness of its theoretical basis. HECTOR MARINO, M.D.

Dulin, J. W., and Peterson, F. R.: Intestinal Obstruction Due to Gall Stones: A Report of 10 Cases. *Arch. Surg.*, 1939, 38: 351.

Although intestinal obstruction due to gall stones is admittedly a relatively rare condition, 10 cases were collected in a period of ten years. These cases account for 5.3 per cent of all intestinal obstructions at the University of Iowa Hospital during the ten-year period. Gall stones large enough to produce obstruction usually pass through a fistula between the gall bladder and the bowel.

The diagnosis of this condition may be very difficult, since the early obstructive symptoms are easily misinterpreted as being due to an acute biliary colic. The onset of acute obstruction in an individual having a previous history of gall-bladder disease should make one suspect the presence of an obstructing stone. A teleroentgenogram of the abdomen may prove diagnostically helpful in two ways: (1) a radio-opaque stone may be observed, and (2) distended loops of small intestine with fluid levels may lead to a diagnosis of obstruction.

In the cases presented the diagnosis was made preoperatively in only 3 of the 10 cases. Surgery was undertaken in 8 of them, as the patients in the 2 other cases were practically moribund on admission. The prognosis is poor in cases of obstruction which is caused by gall stones, as is shown by the fact that only 4 of the 8 individuals who were operated upon survived, and the 2 who were not operated upon died. LUTHER H. WOLFF, M.D.

Bottin, J.: Death in High Obstruction of the Intestine Due Primarily to Intoxication; Dehydration as of Secondary Significance (La mort à la suite d'une obstruction haute de l'intestin est due en première importance à une intoxication et secondairement à une déshydratation). *Rev. belge d. sc. méd.*, 1938, 10: 587.

Formerly death from obstruction of the small intestine was attributed always to intoxication. More recently it was believed that only in obstruction of the lower part of the small intestine could intoxication be considered as the principal cause of death and that in cases of obstruction of the higher portions of the small intestine death was primarily and exclusively due to dehydration. The latter theory has been taken for granted by many writers who have never investigated this problem personally. Those with a better acquaintance of the subject are usually much more reserved in their opinion, and nearly always admit an involvement of both processes. The present writer goes even farther and insists that the cause of death in obstruction of the upper portion of the small intestine is primarily intoxication.

The literature on dehydration and demineralization is reviewed. Animal experiments conducted by the author revealed that, whereas a certain number of animals made interesting recoveries following saline injections, a considerable number showed no effect from this treatment and succumbed. He then studied the animals which survived following enterostomy below the obstruction. The experimental findings of Jenkins and of Jenkins and Bleswick are contradictory to the theory of a primary fatal dehydration in 55 and 77 per cent of the cases, respectively, and thus are in agreement with those of the author.

Even though dehydration and demineralization are common in obstruction of the upper portion of the small intestine, they are far from being constant or constantly acute; even if these conditions are corrected death is delayed in the majority of cases only for an insignificant period. Clinical and laboratory conditions associated with much more marked demineralization and dehydration than noted in high obstruction of the intestine do not usually lead to a fatal termination; if death does ensue, it occurs at a much later period. These facts do not diminish the importance of the factors of dehydration and demineralization. Rehydration and remineralization may prevent death, due to high intestinal obstruction, in more animals than exclusion of the pancreas, but the results are much more inconstant and irregular. The author has performed many experiments with exclusion of the pancreas. He concludes that high intestinal obstruction as well as low obstruction of the small intestines leads to an intoxication, which represents the primary cause of death. The course of the disease depends not upon the existence of dehydration or demineralization but upon the distance of

the obstruction from the duodenopancreatic tract.
EDITH SCHANCHE MOORE.

Lockhart-Mummery, J. P.: Late Results in Diverticulitis. *Lancet*, 1938, 235: 1401.

An analysis of the results obtained in the treatment of 136 cases of diverticulitis is presented. Ninety-one of the author's patients were treated by operation. There were 15 deaths, i.e., a mortality of about 10 per cent of all the cases. In 13 patients the involved portion of the colon was freed from other structures, and omentum was wrapped around it and held in position with fine catgut sutures. A colostomy, usually in the transverse colon, was carried out in the cases of 38 patients. The author believes this to be the most satisfactory type of treatment and the safest method of dealing with severe cases of diverticulitis which do not respond to medical treatment. In 17 patients, the diseased portion of intestine was resected, with temporary cecostomy or colostomy. The artificial anus should remain at least one year, or until all signs of sepsis have disappeared. This is advocated as the ideal treatment when the area involved is small.

Exploratory laparotomy was performed in 43 patients. In this group were many cases of acute perforation with abscess formation which could only be drained. In 2 of the patients, carcinoma developed in the sinus tract. Appendicostomy was carried out in the cases of 5 patients who failed to respond to medical treatment. This procedure may be used instead of colostomy. Twelve patients developed a vesicocolic fistula. In only one instance, however, was this responsible for a fatal pyelitis. All 12 patients were treated by colostomy followed by resection of the infected colon and closure of the fistula, after signs of infection had subsided. Chronic septic foci developed subsequently in 14 patients of the entire group.

It was emphasized that patients with diverticulitis should be kept on a strict mineral-oil régime with a check-up examination by barium enema at yearly intervals. If complications result, despite this careful medical treatment, surgery such as has been described must be carried out, depending upon the type of complication. ROBERT ZOLLINGER, M.D.

Browder, J., and Jett-Jackson, C.: The Surgical Treatment of Congenital Megacolon. *Brooklyn Hosp. J.*, 1939, 1: 5.

Since Wade and Royle reported favorable alteration of obstipation associated with congenital megacolon by lumbar ramusectomy, there have been 22 varieties of operations carried out in the 74 recorded cases, resulting in satisfactory effects in all but 3 instances.

In view of the many types of operative procedures employed to interrupt the sympathetic nerve supply to the colon, rectum, and anal sphincters, the authors review the present anatomical and physiological conception of the autonomical nerve supply to the viscera and anal sphincters. They conclude that the present knowledge concerning the form and function of these nerves is deficient. Of considerable importance, however, is the contention of Telford and Stopford: that parasympathetic fibers arise from the anterior roots of the sacral nerves and form a trunk which joins the ventral aspect of the superior hypogastric plexus. They describe two bundles which can be traced to a point where they converge to meet and pass to the left side of this plexus. This small trunk can be followed cephalad to the inferior mesenteric plexus, which it joins distal to the origin of the inferior mesenteric artery. This, they assert, represents the parasympathetic nerve supply to the distal half of the colon. The parasympathetic innervation of the anal sphincters is derived from the pelvic plexus.

While certain principal anatomical facts seem well established, yet the physiological action attributed to this system of fibers in man is relatively speculative. It may be reasonably stated for general purposes that the parasympathetic influence is excitatory to the smooth muscle of the colon and inhibitory to the internal anal sphincter, while the sympathetic system transmits inhibitory impulses to the intestine and excitatory impulses to the sphincter.

The etiology and pathogenesis of Hirschsprung's disease or congenital megacolon is not clearly understood. The dysfunction of the colon may vary from a complete absence of expulsive power, resulting in death during early infancy, to normal function throughout a long life. The outstanding argument in support of the neurogenic origin of the disease is the observation that not infrequently dilatation of the urinary bladder and ureters can be demonstrated. The authors report 2 such cases. They report a rare type of colon involvement characterized by dilatation and hypertrophy of a short segment of the proximal sigmoid colon. Since this segment was so far removed from the sphincteric influence, it suggests a very peripheral disturbance in the nerve supply. In this case, a presacral neurectomy and division of the colonic sympathetic nerves as they join the inferior mesenteric artery was performed. After completion of this part of the operation, a nerve branch arising from the last lumbar sympathetic ganglion on the left was noted, and since its ramifications could not be identified, the ganglion was removed. Spontaneous defecation occurred on the eighth postoperative day, and has continued twice a day since. Subsequent x-ray studies in this case show the involved portion of the colon unchanged in diameter. In all of these cases, the dilatation and smooth contour of the megacolon persist after sympathectomy, as indicated by comparative x-ray studies, although a good functional result is obtained.

The development of the present-day surgical procedures in the treatment of this disorder has been traced from the various operations on the colon with high mortality and unsatisfactory final results to the acceptance of partial denervation of the colon with good functional results. The end-result depends to a large extent upon the proper selection of the operative procedure to be employed in a given case. No

patient with Hirschsprung's disease should have a sympathectomy until adequately treated with aperient medicines and foods.

The procedure of choice in the female is presacral neurectomy and inferior ganglionectomy. This operation in the adult male results in paralysis of the ejaculatory mechanism, but without demonstrable disturbance in potency. It has been shown that lumbar ganglionectomy, removal of the lower three-paired ganglia, will improve the obstipation even though the chain alone on the left side is excised. This method is to be preferred when subsequent sterility in the male is to be avoided. The recent operation of Adson, bilateral excision of the semilunar and upper two lumbar ganglia, is suggested for use in patients in whom the entire colon is implicated by the disease, or when the dysfunction has not responded to lower lumbar ganglionectomy and/or presacral neurectomy. This operation likewise will produce sterility in the male.

The authors present a chart summarizing 7 cases of congenital megacolon, each of which was subjected to surgical interruption of a part of the sympathetic nerve supply to the colon and anal sphincters. One case required a second operation, since the first was limited to excision of the last two lumbar sympathetic ganglia on the left side, and produced only a transitory beneficial result. This was followed by presacral neurectomy, inferior mesenteric ganglionectomy, and colonic splanchnic neurectomy, which produced a satisfactory functional result.

JOHN E. KIRKPATRICK, M.D.

Wilkie, Sir D.: Surgery of Malignant Disease of the Colon. *Edinburgh M. J.*, 1939, 46: 1.

There are certain factors favorable to successful surgery of the cancer of the colon: its relatively slow growth, its tendency to remain local for many months, and its situation in an organ of which large parts can be extirpated without subsequent impairment in health. On the other hand, there are many factors which introduce difficulty, both with regard to delay in the diagnosis and to success in the operative removal of the disease. Carcinoma of the colon has a long latent period during which it causes few, if any, recognizable symptoms and little, if any, deterioration in health. Until there is a large ulcerative surface or such a narrowing of the lumen of the bowel that interference with the passage of fecal content leads to stasis and symptoms of obstruction, the patient is not alarmed or incommoded and sees no need for medical advice. In all but exceptional cases, therefore, the disease has been present for at least a year before a diagnosis is made. Frequently an extensive growth with secondary anemia, or a constricting growth, causing subacute or acute obstruction, is the condition first found by the doctor.

The operation for removal of a colon growth is rendered difficult and dangerous because of the infective content of the bowel, the uneven contour and varied thickness of the bowel wall, the precarious blood supply, and the liability to flatulent distention.

Clinically we distinguish two types of growth: an annular scirrhous cancer, typically met in the distal part of the colon and liable to cause obstruction, and a fungating ulcerative tumor usually found in the proximal part of the colon, which is liable to bleed, break down, and cause anemia and weakness, but with little tendency to obstruct the bowel.

In the proximal part of the colon, with its absorptive function and consequent free lymphatic drainage, lymph involvement is earlier and more extensive than in the distal part of the colon, the function of which is storage and the lymph drainage of which is therefore sparse. Metastasis to the liver is fortunately not an early complication in the great majority of cases; it occurs less often than in cases of carcinoma of the rectum. It is, however, very prone to occur when the disease affects the distal colon in young subjects. On several occasions the first evidence of trouble in such cases has been the appearance of jaundice with marked hepatic enlargement.

In the proximal part of the colon carcinoma gives rise to constitutional symptoms, in the distal part of the colon to local obstructive effects.

Three forms of x-ray examination are especially useful. A flat roentgenogram of the abdomen may show gaseous distention ending abruptly at the site of the tumor. A barium enema may show complete retention in some part of the colon or a persistent filling defect. If both of the former are negative, a double contrast enema, i.e., a filling of the colon with air after a barium enema has been evacuated, may throw up in relief a polypoid or fungating growth which was obscured by the barium shadow. A barium-meal examination is better avoided. It gives, as a rule, inconclusive evidence, and if there be a narrow constriction the barium may accumulate above it and defy complete evacuation.

In cases of a growth in the pelvic colon or pelvirectal region visual examination through the sigmoidoscope may give the final proof, and in the early case may supply the only convincing evidence that a growth is present. The barium enema roentgenogram is not the alternative to this method of examination; the one should supplement the other.

It is seldom necessary to open the abdomen for diagnosis, and an exploratory operation is not justified until all of the diagnostic methods have been tried.

Successful surgery depends on preparation of the patient, in some cases by drainage of the gut, in others by preliminary immunization or by blood transfusion. The author advocates the combined use of pre-operative inoculation with vaccines of virulent streptococci and colon bacilli, with the stimulation of a pre-operative leucocytosis by the subcutaneous injection of sodium nucleinate the night before operation.

There is one factor favoring gangrene at the seat of a colon anastomosis, and that is the presence of anaerobic organisms within the bowel. These flourish on devitalized material and may cause a spreading gangrene. Hence, the three rows of continuous

suture, employed some years ago, instead of being a safeguard against, were often the cause of the late leakage. The continuous sutures cut off the blood supply from the cut margins of the colon; on these devitalized margins the anaerobes flourished and commenced a spreading thrombotic gangrene in the adjacent wall.

There must be no tension at the suture line and this result is secured by adequate mobilization of the colon so that the ends to be sutured lie together without any pull or drag in the long axis of the bowel. Also, what strain there is must be equally distributed around the circumference of the bowel. In the colon this can be achieved only by dividing the longitudinal muscular bands and so undoing the pouching and puckering which they normally induce. Then, by making a cuff around the bowel down to the submucous coat and applying a light crushing clamp of the Schoemaker type before dividing the bowel, the surgeon can readily bring the cut ends together and unite them by the so-called aseptic anastomosis, using only one row of interrupted Lembert sutures of fine linen thread.

If operation by stages is deemed advisable, an interval, not of days but of weeks, between the stages should be given. Avoidance of tension and conservation of the blood supply to the cut ends of the colon are the secrets of successful end-to-end anastomosis. In all cases in which the liver and peritoneum are not involved, radical operation should be considered even though multiple resections are required. The late results are very gratifying, and indeed better than in any other form of visceral carcinoma. JOSEPH K. NARAT, M.D.

Petacci, M.: Two Cases of Hemorrhagic Infarct of the Cecum. Ileocecocolic Resection. Cure (Due casi di infarto emorragico del ceco. Resezione ileo-ceco-colica. Guarigione). *Minerva med.*, 1938, 29: 448.

Petacci discusses 2 patients who were admitted with the diagnosis of acute appendicitis and who were found at operation to have a normal appendix but a tumefaction of the cecum that was on the verge of perforation. The second case was more serious than the first; both patients presented hemorrhagic infarction of the wall of the cecum with necrosis of part of the mucosa; in both cases, ileocecocolic resection resulted in cure.

These 2 cases represented different stages of the same anatomical lesion: the first case was encountered some time after the occurrence of the hemorrhage and showed partial repair through a reticular sclerosis which caused a cavernous aspect in the intestinal wall with blood between the meshes of the network; the second case was more recent and showed extensive hemorrhagic infiltration, but already gave indications of evolution toward the later stage of the process. All the layers of the cecum in the second case and only the submucosa in the first case were involved. The hemorrhagic infarct explained the tumefaction and dehiscence of the cecal wall, the migration of the bacteria from the mucosa to the muscularis and the serosa, and the invasion of the entire cecal wall by the septic process. The infarct was not due to vascular changes in the mesentery, for which no indications could be found, but to an intrinsic lesion of the cecal wall. This lesion can only have been an angioma with evolution toward fibrous stromatic tissue in the first case, and toward extensive hemorrhage with a slight tendency toward fibrosis in the second case. A somewhat analogous behavior is seen in cutaneous angiomas which, after remaining stationary for a long period, suddenly increase in size, become hemorrhagic, and transform the tissues into a veritable mass of blood.

Simple excision of the cecal wall is insufficient in these cases because the sutures do not hold and the perforations made by the needle constitute a passage for the cecal contents. The softened cecal wall, infarcted with blood so as to acquire a thickness of more than 2 cm., has no tendency toward introflexion and is in imminent danger of rupture under manipulation; while the inflammatory process is not limited, but spreads toward the ascending colon and the ileum. Under the circumstances, resection must be done in healthy tissue and the only recourse is a laterolateral anastomosis of the ileum with the transverse colon. RICHARD KEMEL, M.D.

Gardner, C. E., Jr.: The Conservative Management of Appendiceal Peritonitis. *South. M. J.*, 1939, 32: 157.

The conservative management of appendiceal peritonitis is based upon sound physiological and surgical principles. Immediate removal of the acutely inflamed appendix before perforation represents the only means of controlling the appalling mortality of this disease. In the author's experience, approximately 1 in every 4 patients with appendicitis is admitted with peritonitis. Finney (1933) found 37.5 per cent, Keyes (1934) 50.3 per cent, and Ochsner, Gage, and Garside (1930) 78.7 per cent of patients to have extension of infection beyond the appendix when they were first seen. Operative intervention in the patient with appendiceal peritonitis is a major procedure and it should be undertaken only by the experienced and skillful surgeon. The rationale of delaying operation in cases of appendiceal peritonitis is based upon the fact that a natural protecting mechanism exists within the abdomen, which, if left undisturbed, is usually capable of causing the resolution or localization of the inflammation. This protective mechanism consists of the inflammatory response to the presence of irritation within the peritoneum, and is characterized by the outpouring of an exudate which is bactericidal and which contains leucocytes and fibrin. The fibrin agglutinates the peritoneal surfaces of the bowel, omentum, and abdominal wall in an effort to wall off areas of inflammation from uncontaminated parts of the peritoneal cavity. This being possible, the bactericidal effect of the inflammatory

reaction is sufficient to cause complete resolution of the infection in the majority of properly managed cases. Such a protective mechanism is effective only if left undisturbed. The disturbing element may be any factor, such as food and cathartics, which stimulates peristaltic activity in the bowel, or any mechanical procedure, such as operation, either of which may break up the protective barrier of agglutinated peritoneal surfaces and open the uncontaminated peritoneum to infection.

The author states that his present practice is to treat conservatively all forms of appendiceal peritonitis in children, although formerly operation was delayed only in children in whom localization of the infection was beginning when the patient was first seen. He has used the conservative régime in 26 children. There were 3 deaths. Seven of the children had a generalized peritonitis on admission; in 18, the condition subsided completely and the children were discharged without operation, to return in three months for appendectomy. Of these, 16 entered with, or developed, palpable masses which subsided under the régime. In 7, abscesses formed, which failed to subside and were drained. Two of the last group of patients died, one of peritonitis and the other of a subphrenic abscess. One child with a diffuse peritonitis, who was practically moribund on admission, died without operation.

The author has not hesitated to use the conservative régime in the aged. Although in this group the mortality is higher than that for any other age, it is still lower than the mortality which would occur as a result of immediate operation.

Proper management requires absolute rest of the intestinal tract, maintenance of adequate fluid, mineral and caloric intake by routes other than by mouth, and careful observation for evidence of continued spread of the peritonitis, and increase in size or rupture of an abscess; if these occur immediate operation becomes necessary.

The author reports a series of 111 patients with appendiceal peritonitis who were treated conservatively. In 89 (80 per cent) the condition subsided completely after an average of fifteen and one-half days, and the patients were discharged to return for interval appendectomy in three months. In 17, the condition failed to subside and abscesses formed, which were drained in an average of nine days after admission.

The entire series of 317 patients with perforated appendices who were admitted to the surgical service of the Duke Hospital (Durham, N. C.) in the eight-year period from 1930 to 1938 is divided into 2 groups. During the first four years, when almost all cases were treated by immediate operation, the mortality in the cases of 122 patients was 18 per cent. During the second four years, with consistent use of delayed operation in all patients in whom a definite pre-operative diagnosis of a perforated appendix could be made, the mortality was 9.7 per cent. In the entire series, the mortality from immediate operation was 15.5 per cent, while that following the conservative régime was 8.1 per cent.

The incidence of complication in survivors of delayed operation was 5.6 per cent, and in survivors of immediate operation, 20 per cent. The average period of hospitalization of survivors of immediate operation was twenty-six and two-tenths days, and of the group treated by delayed operation, seventeen and three-tenths days.

ELLA M. SALMONSEN.

Harbitz, H. F.: Hematuria and Renal Calculus as a Complication After Appendectomy. *Acta chirurg. Scand.*, 1939, 81: 405.

A review of 12 cases of hematuria following appendectomy which were personally observed by the author is presented.

The hematuria usually appeared within the first week after the operation and was most common in young females. It was not always of significance, but at times it indicated a serious acute hemorrhagic nephritis ending in complete anuria. In some cases it seemed to be due to the early formation of urinary calculi after the appendectomy. The prognosis was good in all of the cases.

The author suggests an etiological relationship between the formation of the urinary calculi and the postoperative hematuria. ROBERT ZOLLINGER, M.D.

Blaisdell, P. C.: Operative Injury to the Anal Sphincter. *J. Am. M. Ass.*, 1939, 112: 614.

It is amazing how incomplete is the understanding of applied surgical anatomy of the anal-sphincter mechanism and, in consequence, what degree of operative injury is done to this mechanism. The great divergence of opinion and conception of the anatomical structures as reflected in the literature warrant a thorough review of the subject, such as the author has given, which scraps a multitude of misinformed ideas and lays down certain fundamentals. While it is true that in many cases relative and total incontinence result from the vicious practice of postoperative packing, the author points out that these tragedies are in the majority of instances due to injudicious surgical practice based on ignorance of the surgical anatomy of the region. The same factor is responsible to a great degree for the inordinately high rate of recurrence following operations for fistulas. Thus from righteous fear of injury to the sphincter mechanism and unfamiliarity with the applied surgical anatomy in relation to fistulectomy, the balance swings between varying degrees of incontinence on one hand and avoidable recurrences on the other.

Much of the fault for these far too common and unwarranted errors must be laid at the door of the proctologist. While each proctologist has learned by his own experience the practical surgical anatomy adequate for his own use, his written formulations, on which others must depend for guidance, have in many respects proved inadequate and conflicting. A survey of the literature brings out the

astounding fact that almost nowhere, with the notable exception of Milligan and Morgan and an allusion by Hiller, is there any discussion whatever or even mention of the clinical recognition of the various component muscles. Amidst the numerous conflicting statements, practically the only point on which there is apparently almost universal tacit agreement is the fundamental premise that the separate muscles can be easily, accurately, and uniformly recognized at operation. The author is of the opinion that, far from being so simple as to merit almost alone its undebatable position, this fundamental problem of clinical identification of muscles is responsible more than anything else for such divergent expressions. Gross error exists in this basic premise so universally taken for granted.

The author points out that the inaccurate foundation of descriptive anatomy, commonly illustrated but not described, in textbooks, is largely responsible for the common misconceptions pertaining to anal anatomy and the relation of fistulas. Such simple relations depicted between the muscles and the simple and constant relation between fistulas and muscles do not exist, and the resultant clinical misinterpretations and erroneous assumptions are obviously sources of confusion.

For clear analysis, in accordance with conditions as they actually exist, the author maintains that there are only two possible means of differentiating and recognizing these muscles clinically; namely, by palpation and by sight (dissection). Almost exclusive dependence must more often than not be placed on palpation, since operation involves commonly the limited exposure obtained with but a linear section, or little more, of the tissues. This phase of the problem is therefore of major importance.

In attempting to discover other ways and means of recognizing the different structures, the author made numerous dissections in the autopsy room and studied gross and paraffin sections made in the laboratory. By means of these approaches to the problem he brought out the following salient points:

1. It is impossible to define the internal sphincter as a clearcut anatomical entity because no upper border exists, the so-called internal sphincter being but the thickened lower border of the inner circular coat of the bowel. It would be comparable to determining where the handle of a baseball bat ends (Fig. 1).

2. The external sphincter uniformly blends imperceptibly with the levator ani, and tearing of the muscle is usually necessary to separation (except of course at the anterior portion, where the latter does not surround the anus). From the several approaches the author gained the impression that pus extension could readily separate the external sphincter from the (encircled) internal sphincter to the upper border of the former, but that, instead of breaking through here between the external sphincter and levator and thus completely separating the external sphincter, extension would more easily follow the strands of the longitudinal muscular coat of the bowel which course through the external sphincter.

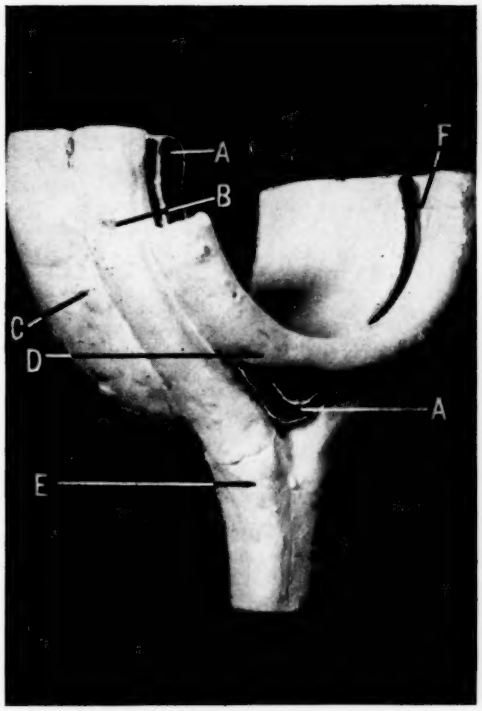

Fig. 1. Model of anal anatomy reconstructed in accordance with paraffin sections and including conceptions of Milligan and Morgan: A, lower border of internal sphincter. A small piece of the subcutaneous portion of the external sphincter has been cut away at the upper left to show how this portion and the internal sphincter are on the same vertical plane. B, superficial portion of the external sphincter with diverging fibers, E, attaching to coccyx. C, deep portion of external sphincter composed entirely of circular fibers. D, subcutaneous portion of external sphincter, consisting entirely of circular fibers which do not surround and support the internal sphincter, as do the superficial and deep portions, but are on the same vertical plane with it, and separated from it by the anal intermuscular septum F.

With this laboratory work as a background, the author states that in all his experience with fistulas he has never found it necessary to identify the internal sphincter, and he believes that, as far as fistula surgery is concerned, reference to the internal sphincter as a clinical entity should be discontinued.

In view of further clinical observations correlated with his laboratory findings, the author suggests that the accepted concept of the surgical anatomy be rearranged to terms of (a) the subcutaneous

portion of the external sphincter and (b) the anorectal ring. The author believes this would obviate many of the difficulties outlined, from the standpoint both of the specialist and of the occasional operator. Recognition of these structures is simple of acquirement; its use is adequate for the purpose and particularly effective because by correct anal palpation one can both continuously follow tracts by their scar tissue and be constantly informed of their relations to the anatomical structures.

MATHIAS J. SEIFERT, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Nadler, W. H.: Indications and Contraindications for Medical Management of Gall-Bladder Disease. *Med. Clin. North Am.*, 1939, 23: 43.

Eight cases of cholecystic disease are reviewed and the subject is discussed from an internist's point of view.

In acute cholecystitis, unless symptoms progress (in which event there is always pre-existing chronic disease with stones), medical measures suffice. In chronic cholecystitis without stones it is pointed out that medical treatment is rational and usually effective, while surgery often fails to relieve symptoms. Cholelithiasis, on the other hand, is a surgical condition because of unpredictable serious complications. Even when the symptoms are slight, unless there are special reasons for a contrary decision, cholecystectomy at the earliest favorable or convenient time seems the safest procedure.

Phemister, D. B., Aronsohn, H. G., and Pepinsky, R.: Variation in the Cholesterol, Bile Pigment, and Calcium-Salts Contents of Gall Stones Formed in the Gall Bladder and in the Bile Ducts, with the Degree of Associated Obstruction. *Ann. Surg.*, 1939, 109: 161.

Clinical and operative studies were made of cases of cholelithiasis and traumatic strictures of the ducts, and chemical analyses, radiograms, and roentgenographic powder diagrams were made of stones which were removed from the gall bladders and common and hepatic ducts. These investigations were made in an endeavor to throw light on the chemical composition of the stones as influenced by the site of formation and by any co-existing obstruction, also on the source of the chemicals themselves, whether they were derived from the bile or from the wall of the gall bladder.

It was observed that stones found in the gall bladder vary greatly in their contents of cholesterol, pigment, and inorganic calcium salts, one important cause of which is variation in the amount of associated obstruction of the cystic duct. Stones very rich in cholesterol may form in the gall bladder when stasis is mild, as judged by the great frequency of dye visualization, and when inflammation is mild or absent, as judged by pathological examination. With increasing chronic obstruction of the cystic duct, there is a tendency for increasing amounts of calcium and bile pigments to be laid down on the pre-existing stones in the gall bladder.

If large stones partition the gall bladder and cause increasing stagnation within, from ampulla to fundus, there is a tendency for any further growth of the stones to consist of materials which increase in pigment and calcium contents from ampulla to fundus. With complete, or almost complete, obstruction of the cystic duct in the presence of low grade chronic cholecystitis, calcium carbonate alone may be precipitated from the gall-bladder fluid as a whitish deposit, either about the pre-existing stones, or as a separate mass.

In contrast with these findings, stones formed in the bile ducts vary relatively little, consisting of bile pigments and cholesterol with very little or no calcium. Obstruction is an important cause of stone formation in the ducts, since it is usually caused by the presence of a stone from the gall bladder which has lodged there. Persistent cholangitis with some degree of inflammatory obstruction appears to be a factor in the reformation of stones in the ducts after cholecystectomy and choledocholithotomy.

Calcium is present very largely as calcium carbonate. The source of the calcium carbonate is the wall of the gall bladder when it is thrown down within the gall bladder while the cystic duct is completely obstructed by a stone. Its source is also the wall of the gall bladder when it is deposited in layers on gall-bladder stones in the presence of high grade but incomplete stone obstruction of the cystic duct. The facts that calcium is laid down in the gall bladder when its outlet is obstructed and that stones formed in the ducts contain little or no calcium are highly indicative that the calcium salts of gall stones are derived from the wall of the gall bladder, and that little or none come from the bile.

The source of the cholesterol of calculi formed in the common duct after removal of the gall bladder is doubtless the bile.

The view that the cholesterol of gall stones formed in the gall bladder is also derived from the bile is favored by the finding of a decreased cholesterol content in gall stones formed when there is increased obstruction of the common duct, while their calcium and pigment contents are increased; also by the absence of cholesterol deposition when calcium carbonate is deposited within the gall bladder in the presence of complete obstruction of the cystic duct.

MANUEL E. LICHTENSTEIN, M.D.

Massé, L., Darmaillacq, R., and Darmaillacq, P.: Glandular Cysts of the Pancreas (Les kystes glandulaires du pancréas). *Bordeaux chir.*, 1939, 10: 10.

The authors have made a complete survey of the literature and present 19 cases in detail. Three unpublished cases are included; 2 were personal observations. The 19 cases include only those in which the glandular nature of the cyst was recognized both at operation and on histological examination.

The authors make the following histological classification of glandular cysts of the pancreas: (1) polycystic disease of the pancreas; (2) cystic lymphangiomas; (3) dermoid cysts; (4) canalicular cysts; (5) cystic adenomas; and (6) cysto-epitheliomas. Under this classification the 19 cases presented 1 polycystic tumor, 2 canalicular cysts, 10 cystic adenomas; 2 adenocarcinomas; and 4 vegetative tumors of the cysto-epithelioma type.

From the histological and pathological studies, two types of cysts are recognized: (1) those which have developed in the pancreas itself, and (2) those which have developed at the expense of embryonic débris included in the pancreatic parenchyma in the course of development. These are the vegetative cysts which behave almost as malignant tumors. Simple marsupialization will cure the first type, but only total excision will cure the vegetative cysts.

The macroscopical appearance of the cysts is as follows:

Most of the cysts have a smooth external wall with a slightly bluish or sometimes yellowish-white appearance. The wall may be covered with very large dilated veins, is usually thickened to at least 2 cm., and is resistant. The interior of the cyst is variable according to the histological nature; it is sometimes unilocular, sometimes multilocular, and sometimes contains budding vegetations. The liquid contained in the cavity may be definitely bloody, chocolate colored, or clear, viscous, and opalescent. The dimensions of the cysts are exceedingly variable.

The pancreatic ferments may all be present or any one or any combination may exist.

The tail of the pancreas is the most frequent site of origin. The complete removal of these tumors presents serious difficulties, for in developing the tumor contacts or adheres to neighboring tissues such as the duodenal arch, the spleen, the splenic pedicle, or the duodenojejunal angle.

The most frequent position of the cysts is intergastrocolic. The tumor compresses the stomach toward the diaphragm and the colon toward the pelvis, and bulges beneath the gastrocolic ligament. Cystic tumor of the pancreas is essentially a disease of adults: 3 patients were under twenty years of age, 3 were between twenty and thirty years, 6 were between thirty and forty, and 7 were more than forty years of age. The extreme ages were twelve and sixty-two years, respectively. As to sex, 15 were females and 4 were males.

There is no definite symptomatology or pathognomonic manifestation which will permit diagnosis of a cyst of the pancreas. In 8 of the 19 cases the tumors were the first symptom; in 5 functional troubles preceded the tumor, and in 6 the tumor and functional difficulties appeared simultaneously. Digestive troubles are frequent. A pancreatic syndrome of the external secretions has not been noted, nor is there glycosuria. Emaciation was noted in 5 cases. In 7 cases the tumor was located in the epigastric region, in 6 it was definitely located in the left hypochondrium, and in 3 it was to the right of the umbilicus. In 12 cases the tumor was mobile, and in 3, immobile.

Roentgenological examination through the use of a barium enema or barium in the gastro-intestinal tract may help in the diagnosis by showing the organs markedly displaced. Urography is of value, as an exact pre-operative diagnosis has been made in several instances by this means. Rupture into the peritoneum and jaundice are rare.

As regards treatment, these tumors should be excised because they are almost insensible to roentgen rays. Two methods of treatment may be used: marsupialization of simple cysts of the pancreas without vegetation, and excision either of the cyst alone or of the cyst including part of the pancreas. In tumors with intracystic vegetations, only complete extirpation will give a cure, although a cure is not always technically possible. Only tumors limited to the tail justify pancreatectomy and then only if they are sufficiently free.

The operations in these 19 cases were: 2 pancreatectomies (left) with 1 death; 2 enucleations; 5 complete extirpations; 1 large but incomplete extirpation; and 9 marsupializations with 1 death.

RICHARD J. BENNETT, JR., M.D.

Gripwall, E.: Hereditary Hemolytic Icterus and the Red Blood Cells (Zur Klinik und Pathologie des hereditaeren haemolytischen Ikterus, mit besonderer Beruecksichtigung des Verhaltens der roten Blutkoerperchen). *Acta med. Scand.*, 1938, Supp. 96.

This monograph is based on a study of 30 patients with hereditary hemolytic jaundice. In 21 cases the disease was familial. Splenectomy was done in 8 patients, in 4 instances at an earlier period of life. Special studies were made of jaundice, anemia, splenomegaly, spherocytosis, and reticulocytosis, as well as of the increased red-cell fragility in hypotonic sodium chloride solutions. That all of these characteristic findings may not always be present in a given case was confirmed. There is great individual variability according to the intensity of the hemolysis and the adaptability of the organs that play an active part in blood formation. The anemia and the degree of jaundice show no definite correspondence, nor do the increase in red-cell fragility and the degree of anemia and jaundice, respectively. The sedimentation reaction revealed a peculiar type of "veiled sedimentation." The red blood cells were more vulnerable to heat treatment than normal blood corpuscles.

The studies carried out warranted the following conception of the pathogenetic mechanism: "The disease is based on a primary, hereditary anomaly in the red corpuscles, which expresses itself both in a characteristic change in the shape of the red corpuscles and a decreased resistance to hypotonic sodium chloride solutions as well as to lysolecithine. As an essential morbid factor there is added to this anomaly an increase in the spleen's physiological blood-destroying function due to an increased endopause-function. Through the abnormal func-

tion of the spleen the disposition of the disease is made manifest."

The prognosis is generally good, but acute "deglobulization" may be caused by various exogenous factors, notably infections. According to the unanimous experiences in the literature it cannot be doubted that splenectomy is the only safe therapeutic recourse. The risk of relapse after splenectomy is discussed, and cases described in the literature are reviewed. WALTER H. NADLER, M.D.

Polowe, D.: Splenectomy in the Treatment of Proved Subacute Bacterial Endocarditis: Report of a Case and Review of the Literature. *Arch. Surg.*, 1939, 38: 139.

Splenectomy was performed in 4 cases of proved subacute bacterial endocarditis and in 12 unproved cases. In the proved reported case the patient is alive and well more than twenty months after the operation. In the group of unproved cases, 2 patients were alive and well at the time of the report, and 4 patients lived from six to twelve months. In most of the cases in both groups the pain was relieved, and it was the impression of most of the attending physicians that the patients had benefited from the procedure.

False positive Wassermann reactions may be obtained in some cases of subacute bacterial endocarditis.

It appears that the case reported is the first proved case of subacute bacterial endocarditis in which the patient recovered after splenectomy.

SAMUEL KAHN, M.D.

MISCELLANEOUS

Thieme, E. T.: A Critical Survey of Peritoneoscopy. *Surgery*, 1939, 5: 191.

By peritoneoscopy is meant the direct inspection of the abdominal cavity by means of an optical instrument. The diagnostic possibilities of peritoneoscopy seem to merit a more widespread interest, especially in view of the satisfactory results and the safety with which this procedure can be carried out. In order to determine the diagnostic value of peritoneoscopy, a critical survey was conducted at the University Hospital, Ann Arbor, Michigan. The results of observations carried out on 50 selected cases are reported by the author.

Peritoneoscopy was rarely used as the preliminary study. In most instances it was resorted to after other means could supply only an inconclusive diagnosis, or when biopsy or the operability of a clinically suspected neoplasm was desired. Peritoneoscopy was found to be entirely safe and very accurate. It is so accurate that it has come to be considered a valuable final authority in diagnosis, which supplies much of the information usually gained by laparotomy with only a fraction of the expense and morbidity of a major operation.

The technique employed was essentially that described by Ruddock. Patients were prepared as for laparotomy and all examinations were carried out aseptically. In order to allow more room for observation an enema was given, which was followed by the administration of 1 c.cm. of pitressin to reduce intestinal volume. Morphine sulfate was the only sedative used. One per cent of procaine for local anesthesia was used, and only the site of puncture was anesthetized. Local infiltration extended to all layers in an area of from 6 to 10 cm. from the puncture site. As a result, greater distention of the abdomen and painless manipulation of the instrument were possible. The incision was generally placed in the rectus muscle at the level of the umbilicus. As a matter of routine a nick in the fascia was made to facilitate the introduction of the large trocar. Room air of an unknown quantity and pressure were used for the pneumoperitoneum. In all instances the observations were successful, though occasionally limited by adhesions.

Only cases that had been thoroughly studied by other means were accepted for peritoneoscopy, from which the proper diagnosis from an array of clinical possibilities presented by a large teaching staff was expected. In a high percentage of cases the diagnostic problems presented in these situations were settled by peritoneoscopy.

The author divides the cases studied into the following general groups: (1) liver and spleen syndromes, (2) suspected abdominal malignancies, (3) unknown masses in the abdomen, (4) ascites of unknown origin, and (5) tuberculous peritonitis.

With regard to the liver and spleen syndromes, the clinical diagnosis of jaundice or of hepatosplenomegaly can seldom be accurate. It must, however, be obtained to guide rational treatment. The problem is accurately answered by peritoneoscopy, and the therapeutic approach in jaundice and in hepatosplenomegalies is therefore indicated.

With regard to abdominal malignancies, the author states that clinical findings alone cannot accurately disclose the inoperable carcinoma of the stomach and peritoneoscopy should be used routinely to avert operation in inoperable cases.

As to identification of unknown masses in the abdomen, peritoneoscopy must be recommended with reservations. The extent of pelvic and abdominal neoplasms can be accurately estimated for proper treatment, but peritoneoscopy cannot be expected to identify retroperitoneal masses unless they are far advanced.

Referring to ascites of unknown origin, the author states that with thorough clinical study before peritoneoscopy the group of ascites of unknown origin will continue to be small, but that peritoneoscopy may be expected to give the correct diagnosis.

Abdominal tuberculosis can be readily diagnosed and its course should be followed by repeated peritoneoscopic examinations.

It has been demonstrated repeatedly that peritoneoscopy, used as a final check-up after other clinical diagnoses have been made, may reveal a

condition which is entirely at variance with these diagnoses and that a correction in the diagnosis may change the prognosis entirely.

MATHIAS J. SEIFERT, M.D.

Mondor, H., and Olivier, C.: Spontaneous Hemoperitoneum in Men (L'hémopéritoine spontané chez l'homme). *J. de chir.*, 1939, 53: 1.

Spontaneous hemoperitoneum in the male patient does not merit its reputation of rarity, and the condition should not be limited in the minds of surgeons to women alone, in whom the frequent cause is ectopic pregnancy. The authors have reviewed 400 cases of hemoperitoneum in men and women (of nongenital origin in the latter), and they found that in only 9 of this number was the source of the bleeding "below the level of the umbilicus." It may be said that in men in whom intraperitoneal bleeding is suspected, the bleeding point may be expected to lie "above the umbilicus."

The most frequent site of the bleeding is in the spleen or one of its large vessels, but spontaneous rupture of any mesenteric, hepatic, or gastric artery, or even of the abdominal aorta itself, is also a possibility. Obviously, there are still other more obscure possibilities, many of which the authors point out.

The clinical picture must be thought of in terms of chronology, as the symptoms change with time. First there is usually upper abdominal pain, but as a rule there is not much change in the pulse or temperature. With the passing of time there may be some increase in the temperature, variable pulse changes, increasing pain, the appearance of abdominal rigidity or distention, and, occasionally, vomiting. The temptation is to diagnose the condition as a ruptured peptic ulcer, or, less likely, intra-abdominal mesenteric hernia or volvulus, or bowel obstruction of undetermined origin. Almost invariably the incision should be made "above the level of the umbilicus," and the surgical procedure should be one directed to the discovery of the site of the bleeding. This task is always more difficult in the upper abdomen than it is in the pelvis.

JOHN MARTIN, M.D.

GYNECOLOGY

UTERUS

Black, W. T.: Chronic Cervicitis. *J. Am. M. Ass.*, 1939, 112: 191.

A specimen for biopsy should be taken from every lesion of the cervix wherein there appears to be even the slightest possibility of malignant change.

A bacteriological study of 103 cultures showed that staphylococci and streptococci predominated.

Chronic cervicitis as a focus of infection should receive more thoughtful consideration. Pelvic pain, backache, menorrhagia, and, at times, distant symptoms may be relieved by cure of an infected cervix. A gain in weight and correction of nervous instability are often noted after proper treatment of a cervical infection.

Penetration of the uterine cavity materially increases the danger of infection, as trauma opens an area for bacterial invasion. Amputation should not be performed during the child-bearing age. A Sturmdorf operation or a modification of it is preferable. Plastic surgery still has a place in the treatment of cervical lesions in selected cases. Electrosurgical measures, however, have almost superseded other methods. A trachelorrhaphy is indicated for a laceration more than 1.5 cm. in length; smaller lacerations are best treated with the cautery as the result is equally good and there is less danger of subsequent malignant change. The choice between cauterization and conization should be based on the type of cervical lesion found, i.e., whether it consists of a laceration, cystic formation, or extensive hypertrophy. The nulliparous cervix or the multiparous cervix without extensive disease may be treated by an electrosurgical procedure in the physician's office. In the presence of marked hypertrophy, many cysts, and wide laceration, or when the patient is very nervous, the treatment should be carried out in the hospital with the help of a gas anesthetic.

If treatment is selected according to the nature of the lesion and the age of the patient and the necessary postoperative care is given, the outcome will, as a rule, be successful. Proper care of the diseased cervix will reduce malignant changes to a minimum.

CHARLES BARON, M.D.

Collins, D. C.: The Management of Tuberculosis of the Cervix Uteri. *J. Am. M. Ass.*, 1939, 112: 605.

This study is based on a consideration of 191 cases of tuberculosis of the cervix. Six of these are new cases which the author is reporting for the first time; the others were collected from the literature. Fully 85 per cent of cervical lesions are secondary to a tuberculous focus elsewhere in the body; 55 per cent accompanied genito-urinary tuberculosis.

In the female generative tract, tuberculosis occurs most frequently in the fallopian tubes, and the incidence of the disease progressively diminishes in inverse proportion to the distance of the structure from the fimbriated end of the tube. It usually results from a descending infection that is spread by contiguity from foci situated higher in the pelvis, although it may reach the genitalia by the hematogenous or lymphatic routes.

Primary tuberculosis of the cervix is rare, and, for a given case to be classified as primary, the cervix must be the only tuberculous lesion which the patient harbors. Among the 185 cases collected from the literature there were 16 with primary lesions, and the author believes that the lesion in 1 of his 6 additional patients was also an example of this primary type.

The local lesion in the cervix may be ulcerative, papillary, miliary, or, rarely, the bacillary catarrhal type. The typical lesion is ulcerative, but it must be differentiated from hypertrophy of the cervix accompanied by eversion, erosions, myomas, polypoid tumefactions, and also from gonorrhea, syphilis, actinomycosis, and sarcoma; of course, the usual differential diagnosis is from carcinoma. Tuberculosis of the cervix is so rare and may assume such varied appearances that it rarely can be recognized at once, and almost invariably biopsy must be performed for a diagnosis. It may give rise to vaginal bleeding, even severe hemorrhages. It is not at all infrequent for the patient to complain of a foul leucorrheal discharge.

The preferred treatment is radical surgery. The operation should include a total hysterectomy with removal of the tubes, because there is usually extensive tuberculous disease of the upper generative tract; it is desirable to save one ovary, if it is healthy. Local treatment of the cervical lesion is not advisable. X-ray and radium therapy often prove disappointing. Nevertheless, one sometimes is forced to resort to less radical measures because of certain contraindications to radical surgery, e.g., advanced local tuberculous lesions with extensive involvement of the bladder or rectum, severe tuberculous salpingitis, marked secondary infection, or active tuberculous foci elsewhere in the body.

The ultimate prognosis in tuberculosis of the cervix is dependent on the type of treatment employed, together with the presence or absence of active tuberculosis elsewhere. GEORGE H. GARDNER, M.D.

Papin, F., Barroux, R., and Meigné, J.: Hemangiomas of the Uterus (Les hémangiomes de l'utérus). *Rev. franç. de gynéc. et d'obst.*, 1938, 33: 833.

Papin and his associates note that hemangiomas of the uterus are of rare occurrence; they have found but 28 cases reported in the literature. They have analyzed 22 of these cases, and report 1 case which had been operated upon ten years ago but had never been reported.

In the authors' case the patient was a young woman twenty years of age with a large uterine tumor which had developed very rapidly and caused repeated uterine hemorrhages; a sarcoma of the uterus was suspected and hysterectomy was done; histological examination showed a cavernous hemangioma. Of the reported cases, only 4 were of this type of cavernous hemangioma which caused a considerable enlargement of the uterus. Three of the patients had repeated hemorrhages, which were severe in 2 instances.

Histological study of the tumor in the authors' case revealed that the vascular walls were of an embryonic type without the normal layers of blood-vessel walls. In this case there had probably been a preliminary fibrosis in the walls of some of the capillaries which caused circulatory stasis and dilatation; the periodic menstrual flow was a factor in furthering this vascular dilatation.

The most common types of uterine hemangioma are localized mural or submucous angioma, and fibro-angioma; nearly 20 such cases have been reported. These tumors are small, but cause considerable bleeding. They were found either at autopsy or upon examination of the uterus after hysterectomy for repeated hemorrhages. Three cases of pelvic telangiectatic hemangiomas have been reported. Hemangiomas are not, strictly speaking, uterine tumors, but are dilatations of the periuterine plexus in close contact with the uterus. One case of intra-uterine cirsoid aneurysm also has been reported. ALICE M. MEYERS.

Stevens, R. H., and Payne, A. K.: A Survey of 293 Cases of Cancer of the Cervix Uteri. *Am. J. Roentgenol.*, 1939, 41: 55.

The authors present several tables of statistics concerning 293 cases of carcinoma of the cervix, 223 of which were treated by radiation therapy prior to 1933. In the list of 223 cases treated before 1933 there were 9 cases (4.4 per cent) of carcinoma of the cervical stump after supracervical amputation for fibroid tumor, or after deduction of the cases unproved by biopsy there were 5 cases (3.8 per cent) of squamous-cell carcinoma in cervical stumps. Of the 223 cases, 137 were proved by biopsy and 20.4 per cent of these were cured for five years or more; that is, 20.4 per cent of the "run of mine" cases. Broders' grading was used in nearly all cases in which biopsy was done. It appears that at least some tumors with a low grade of malignancy are radiosensitive, while many of those with the higher grades are not.

Eleven patients in whom cauterization by the Percy soldering iron or by the electrocautery was done previous to irradiation did not live through the five-year period.

For some time the authors have been concerned about the influence of infection in the treatment of carcinoma of the cervix. They are fully convinced that many more cases would be cured if ample time could be taken (one or two weeks) to prepare the patient for radiation treatment. As pointed out by Regaud several years ago, cancer and infection thrive together. It is probable that the traumatism of biopsy and of dilatation of the cervix for the insertion of radium-carrying tubes would tend to spread infection from the vagina. Roentgen rays in moderate dosage seem to control many types of infection. They are applied without surgical aid such as is necessary in the application of radium in the uterine cavity. Therefore, the authors stress the administration of roentgen therapy in moderate dosage before radium therapy. JOSEPH K. NARAT, M.D.

Schmitz, H., Schmitz, H. E., and Sheehan, J. F.: The Action of Doses of 800 Kilovolt Roentgen Rays on Carcinoma of the Uterine Cervix. *J. Am. M. Ass.*, 1939, 112: 17.

The solution of the problem of adequate control of carcinoma of the uterine cervix by irradiation with roentgen rays of about 800,000 voltage, requires the study of the clinical aspects of the disease, the etiology, pathology, and symptomatology, as well as of the effect of the irradiation on the tumor and the cancer cells.

The favorable results of irradiation depend on many factors, such as the histological index of malignancy, the sensitivity or resistance to irradiation, and the dose of irradiation applied at the periphery of and within the tumor.

The dose of irradiation is the product of the quality or intensity of the irradiation and the duration of its application. The factors used in the production of the roentgen ray determine the quality. There were 800 kilovolts (maximum) obtained from a double pulsating Villard current with a load of 10 ma. on the x-ray tube (which was rendered free from gas by oil vacuum pumps), a water-cooled tungsten target, a filter equivalent to 10 mm. of copper, a focal skin distance of 70 or 86 cm., field sizes varying from 10 to 20 sq. cm., and a half value layer of 8.2 mm. of copper, corresponding to an average wave length of 0.028, or a minimum wave length of 0.0128 angstrom unit.

Within from seven to ten days after the beginning of treatment, hyperemia and capillary injection of the surface around the growth were seen. During the second week a whitish pseudomembrane covered the cervix, and after twenty-eight days necrosis appeared, which produced a blackish-green discoloration of the bed of the growth. From the sixth to the eighth week the necrotic tissue separated, was cast off, and left a granulating surface. This was followed by epithelization when the prognosis was favorable, and by persistence of granulation or friability of tissue when it was unfavorable. Biopsy alone could show whether the condition was radiation necrosis, arrest of the growth of the tumor cells, or recurrence or continuance of the primary carcinoma. Recurrence or persistence of the primary carcinoma requires additional treatment by irradiation.

The microscopic changes in the carcinomas included: (1) swelling of the cytoplasm and nuclei of

the tumor cells, the cytoplasm staining palely basophilic, and the nuclei becoming more vascular with accentuation of the nucleoli; (2) loss of regularity in the pattern of the tumor with increasingly great variation in size, shape, structure, and staining qualities of the nuclei; (3) increasing cornification in the masses of tumor cells predisposed to cornification; (4) relative increase in abnormal mitoses and increase in the number of cell monsters, i.e., cells with giant hyperchromatic nuclei or multiple nuclei; (5) obliteration of the boundaries of cells; (6) the occurrence of bizarre nuclear forms, with irregularities of the nuclear membranes; (7) karyolysis, particularly marked in cells with palely basophilic, swollen cytoplasm; (8) pycnosis, most marked in cells with giant hyperchromatic nuclei and rather strongly eosinophilic cytoplasms; (9) neutrophilic infiltration in partially or completely cornified masses of cells; (10) the presence of foreign-body giant cells in apposition to masses of keratin; (11) fine and coarse vacuolation of the tumor cells, and (12) decrease in the size of sheets of tumor, with relative increase in the amount of stroma.

The changes in the fibromuscular coat of the cervix included: (1) surface ulceration with necrosis and neutrophilic infiltration; (2) a zone of edema beneath this layer, with swelling of the capillary endothelium and granulations; (3) swelling of the collagen and ultimate hyalinization, often most marked around the capillaries and arterioles, particularly in the deeper tissues; (4) necrosis of the capillary endothelium and the walls of the arterioles, with thromboses noted only at the margin of the necrotic surface; (5) swelling of the collagen and hyalinization in the subendothelial tissues of the walls of the small arteries, with narrowing or occlusion of the lumens and, rarely, with thrombosis, which was more marked in the deeper vessels; and (6) atrophy of smooth muscle.

In the non-cancerous cervical epithelium, edema, vesiculation, and desquamation of the stratified squamous epithelium were noted. Relatively little variation in the columnar epithelium was encountered.

By the end of the first week of therapy (after the administration of about 1,000 roentgens) the most notable change was rather uniform, moderate swelling of the cytoplasm and nuclei of the Group-1 tumor cells. The swollen cells had a palely basophilic, finely reticulated cytoplasm, and their nuclei showed some vesiculation with accentuation of the nucleoli.

By the end of the second week (after the administration of about 2,000 roentgens) a more marked effect was evident. Much of the regularity in the pattern of the untreated tumor had been lost. In tumors with Group-1 cells (not readily cornified) more marked variations in size, shape, and staining qualities of the nuclei were noted. Numerous cells of the large eosinophilic type with enlarged nucleoli were noted. Some of these were pycnotic. However, the large, palely basophilic type predominated. Fine vacuolation of the cytoplasm and fading of the nuclei were noted in many of these. In tumors composed of Group-2 cells (readily cornified), the cornification of the central cells in the tumor masses had progressed at the expense of the mantle layer of spinal and transitional cells around them. The changes noted at this stage in the Group-1 cells had occurred in this mantle layer.

By the end of the third week (after about 3,000 roentgens had been administered) the sheets of tumor cells were smaller than before, and the cytoplasms and nuclear boundaries more irregular, poorly defined, or even indistinguishable. In tumors with Group-1 cells, swelling seemed to have reached or to have passed its peak. More bizarre nuclear forms were noted. Vacuolation of the cytoplasm was rather marked. In tumors with Group-2 cells cornification was much more extensive, some nests of tumor cells being completely cornified. The few transitional cells and spinal cells which persisted as a poorly defined mantle around some cornified cells showed changes described at this stage for Group-1 cells.

By the end of the fourth week (after treatment with about 4,000 roentgens), the qualitative changes in Group-1 (non-cornifying) cells were about the same as at the end of the third week, but quantitatively more cells of the large eosinophilic type were noted; and in these there was greater irregularity in the shape and outlines of the nuclei. Pycnosis in these was much more pronounced. Some of these giant nuclei, robbed of cytoplasm, persisted as large basophilic smudges. However, the large, palely basophilic cells were also in evidence. Karyolysis in these was much more marked, some of the cells having lost their nuclei entirely.

No prognostic significance could be attached to the presence of numerous eosinophils in the inflammatory exudate of the tumors included in this series. In 2 cases, in which their presence was a rather prominent feature, the carcinoma had disappeared by the end of the second week of therapy. However, in some cases in which the carcinoma persisted or recurred, eosinophils were also in evidence, particularly in 1 case in which recurrence and even invasion of the broad ligaments were noted shortly after the completion of therapy.

J. Thornwell Witherspoon, M.D.

ADNEXAL AND PERIUTERINE CONDITIONS

Simonnet, H., and Robey, M.: Physiology of the Corpus Luteum; the Corpus Luteum of Menstruation (Physiologie du corps jaune; le corps jaune menstruel). *Gynéc. et obst.*, 1939, 39: 13.

Simonnet and Robey note that in some species of animals the corpus luteum phase is of short duration and minor importance. In women, the corpus luteum persists fourteen or fifteen days, as shown by histological studies of ovaries removed at operation in different phases of the menstrual cycle. Experimental studies dealing with the function of the

corpus-luteum hormone give somewhat contradictory results. However, it has been shown that the corpus-luteum hormone (progesterone), acting synergistically with folliculin, produces changes in the endometrium; it also acts to inhibit the secretion of folliculin through the pituitary gland at the end of the menstrual cycle. If fertilization of the ovum and pregnancy do not occur, the luteinizing factor of the gonadotropic anterior pituitary hormone is replaced by the folliculin-stimulating hormone, and the corpus luteum degenerates.

The rôle of the corpus luteum is definitely subordinate to that of the follicle; it functions only secondarily to the action of the follicular hormone. The follicular hormone is the essential ovarian hormone that is responsible for the female sex characteristics. The corpus-luteum hormone acts synergistically with the follicular hormone, but only temporarily, even in the period when its influence is preponderant, i.e., in pregnancy. ALICE M. MEYERS.

Simonnet, H., and Robey, M.: Physiology of the Corpus Luteum; the Corpus Luteum of Pregnancy (Physiologie du corps jaune; le corps jaune gravidique). *Gynéc. et obst.*, 1939, 39: 5.

Simonnet and Robey state that the corpus luteum is formed by luteinization of the follicle under hormonal stimulation; if ovulation has occurred a true corpus luteum is formed; but luteinization may occur in the absence of ovulation with the formation of a false corpus luteum. The corpus luteum of pregnancy is a true corpus luteum; prior to fertilization of the ovum, it maintains the nutrition of the ovum during its passage through the fallopian tubes and determines the pregravidic changes in the uterine mucosa, for which the preliminary action of folliculin is necessary. When fertilization of the ovum has occurred and nidation is complete, the corpus luteum does not regress but persists and undergoes certain changes, as shown by the appearance of colloids and the increase in lipoids; the maturation of follicles and ovulation are suspended during pregnancy.

In some species of animals the excision of the corpus luteum interrupts pregnancy at any stage, but in other species and in human beings, the presence of the corpus luteum is necessary only in the first part of pregnancy. Experiments have shown that in the latter group the placenta contains a principle which has an action similar to corpus-luteum extract in its effect on the endometrium and its inhibiting effect on the uterine contractions. This does not indicate, however, that under normal circumstances these functions, which are necessary for the maintenance of pregnancy, are not exercised by the corpus luteum. Involutional changes in the corpus luteum do not occur until later in pregnancy, and, finally, the luteinizing action is suspended at the time of labor when quantitative and possibly qualitative changes occur in the estrogenic hormones. The secretion of milk depends primarily upon the action of a specific hormone of the anterior pituitary lobe, but in order that this hormone may act, the mammary gland must have been prepared by the synergistic action of folliculin and progesterone during pregnancy. ALICE M. MEYERS.

Minne, J., and Gernez, L.: Ovarian Cysts in Children (Le kyste de l'ovaire chez l'enfant). *Gynécologie*, 1938, 37: 641.

The relatively rare incidence of ovarian cysts in children has been the cause of the frequent errors in diagnosis of this condition. From the literature since 1869 the authors have been able to collect 245 cases in children up to fifteen years of age. In thirty years of personal experience they have seen only 5 cases; in 1 of these, which occurred in a newborn infant, the cyst was very small. A study of the age incidence showed that 60 cases occurred in children up to five years of age, 57 cases in children from five to ten years, and 103 cases in children from ten to fifteen years of age. In a few isolated cases heredity seemed to have played a part, similar cysts having been removed from mothers of the patients. Cysts of the ovaries have been observed in twins and in 2 sisters, and 1 interesting case is reported in which a girl of fifteen years was operated upon for a cyst of the right ovary while her brother, at the age of eighteen years, was operated upon for cystic disease of the testicle, and her mother presented a cyst of the vagina.

Among conditions mentioned as possible predisposing factors are listed bacillosis, lymphatism, anemia, and masturbation with resulting pelvic congestion and congenital malformation. Some writers have insisted upon a racial influence, finding the condition most common in the Anglo-Saxon race. In India the condition is unknown.

The dermoid type of cyst was most common, having constituted 46 per cent of the cases; mucoid cysts occurred in 43 per cent and a mixed type of cyst occurred in 11 per cent. The side affected was not always recorded. Of 138 cysts, 70 were on the right side, 53 on the left side, and 15 were bilateral.

Histologically, the dermoid and mucoid cysts show the same characteristics as in adults. Cysts of mixed type are apparently more common than hitherto suspected.

The cysts vary in size, those of the mucoid type sometimes attaining an enormous size and weight in proportion to the age and height of the child. Cases have been reported in which the cyst weighed 50 kgm. and was as large as a six months' pregnancy. The great length of the pedicle of most of these cysts is one cause of their frequent torsion, although torsion has been described also in cysts with short pedicles. Adhesions formed in about one-sixth of the cases, usually in the cases complicated by infection or torsion.

Complicating lesions of adjacent organs are likewise dependent upon infection and torsion of the cyst, but may also be encountered in association with very large uninfected cysts. Such lesions include aseptic peritoneal reactions with effusion, the

latter being frequently blood-tinged in cases of torsion; uterine displacement; cystic disease of the other ovary; congestion of the tubes; cysts of the pouch of Douglas; appendicitis; compression of the bladder; purulent cystitis; and compression of the ureter with dilatation of the pelvis. The uterus or tubes may be included in the torsion.

As regards the symptoms, 42 per cent of the cases were manifested by some complication. The period of latency is characterized usually by functional symptoms including attacks of abdominal pain, gastro-intestinal disturbances, urinary disorders, and precocious puberty. Among the physical symptoms noted may be mentioned an enlargement of the abdomen, caused usually by a veritable tumor, not merely by distention. General symptoms are rare. Emaciation without demonstrable cause may be noted. An analytical study of these symptoms is presented on the basis of the cases reported in the literature.

The pathogenesis of the most common complication, torsion, is probably best explained by the theories applied to this condition in adults, that of oblique pressure being the most plausible. The symptoms of torsion in children may be classified in three groups. There may be (1) a sudden onset with fulminant evolution (23 cases), (2) successive attacks of torsion and detorsion of subacute nature (20 cases), or (3) slow, insidious torsion usually discovered only at autopsy or operation (11 cases). Sudden pain, nausea, and vomiting, gastro-intestinal disturbances, urinary disorders, urinary retention, and pyuria may be observed. Illustrative cases are described and the physical and general symptoms of torsion discussed. Acute torsion may result in gangrene of both tumor and pedicle with final fatal peritonitis, unless an early intervention is instituted. In 1923 Powell performed hysterectomy for such a condition in an infant of five months.

Nine cases of rupture of an ovarian cyst in children have been reported in the literature. The type of cyst was stated in only 6 of these, 4 being mucoid and 2 dermoid. Rupture occurred usually as the result of violent effort in games. In some cases there may be a direct trauma with sudden rupture. In other cases the rupture may develop more gradually. Rupture may occur following suppuration or during delivery. A case of rupture into the bladder has been reported. In 4 cases suppuration of the sac of the cyst was described. In Patterson's case suppuration of the cyst was due to the introduction of a foreign body into the genital tract. If the cyst has been detected first, diagnosis in such cases is easy. Three of the 4 cases ended in recovery. More or less abundant intracystic hemorrhages are frequently discovered at operation.

Among other less frequent complications may be mentioned tuberculosis of the sac, hernia of the cyst, and distant complications such as ascites, pleurisy, urinary retention, intestinal occlusion, and asphyxia.

For purposes of diagnosis the pain symptom is not sufficiently characteristic to be of much value. Constipation and urinary retention are very common. Menstrual disturbances are less frequent but of considerable diagnostic value, as are likewise disorders of puberty and anomalous secondary sex characters, which indicate ovarian dysfunction. Once the tumor has attained some size, compression of the abdominal organs also may give a clue. The typical "ovarian facies" is rarely seen in children unless the cyst is out of all proportion to the size of the child. Physical examination may reveal a diffusely distended abdomen, and a clearly defined abdominopelvic tumor of smooth surface and more or less hard consistency, which as a rule is very movable. In the absence of abdominal symptoms, rectal or vaginal palpation may reveal a pelvic tumor. Rectal palpation should be a routine procedure as it will yield valuable information in two-thirds of the cases. Vaginal palpation is more difficult. Roentgenography should be practiced more frequently than is the custom. Other methods of examination which may be of use are uterosalpingography and rectal insufflation. Puncture, which was used so much in former days, has been abandoned on account of the dangers involved.

In the differential diagnosis of ovarian cyst in children, one has to consider ascites, tuberculous peritonitis, megacolon, tuberculosis of the mesenteric glands, the enlarged abdomen of rickets, abdominal tumor, pregnancy, renal tumor, hydatid cysts of the liver and spleen, cyst of the mesentery, hematosalpinx, tumor of the posterior cavity of the omentum, wolffian cysts, urinary retention, and pelvic tumor. Among the conditions which have to be taken into consideration in differential diagnosis of the complications of ovarian cysts in children, the authors mention acute appendicitis, intestinal invagination, and intestinal occlusion. Encysted tuberculous peritonitis, strangulated hernia, acute peritonitis, pneumococcic peritonitis, and less frequently pelvic abscess, nephritic colic, and perinephritic phlegmon, and, in older girls, adnexal tumor, extra-uterine pregnancy, hematosalpinx, and hematometra may also enter into the differential diagnosis of ovarian cysts. A positive diagnosis of rupture is based on the finding of an acute peritoneal syndrome. In cases of suppuration the first thought is usually appendicitis or purulent appendiceal peritonitis. A vesicular or adnexal origin is much less common.

As regards treatment, no details could be obtained in 44 cases, and 20 cases were diagnosed at autopsy. Medical treatment was attempted in only 3 cases, and consisted in puncture not followed by surgical operation; it is of historic interest only. Following puncture, the fluid re-forms very rapidly and in the past century it was customary to repeat this dangerous procedure as many as 3, 4, 5, or even 6 times.

In all cases coming to operation, in which puncture had been performed, exeresis was considerably hindered by fluid in the abdomen or by peritoneal, omental, or intestinal adhesions. In more recent

cases puncture has usually been performed only because of a mistaken diagnosis of ascites or peritoneal tuberculosis. Ovariotomy was done in 114 cases. In 5 cases a bilateral ovariotomy was required. Once diagnosis is established, a subumbilical median laparotomy is performed, which has occasionally to be extended above the umbilicus in very large cysts in young children. About 1 in every 18 cases requires puncture to permit exteriorization because of the large size of the cyst. In cases in which diagnosis was not certain the oblique incision, paramedian laparotomy, or paralateral laparotomy has been done. Ligation of the pedicle is simple in the absence of adhesions. The latter are common in cases with torsion and may necessitate multiple omental resections for liberation. Sigmoid, hepatic, and abdominal wall adhesions have been reported. Lee Secor described a fissure of the cyst. Several writers have noted bloody fluid in the abdominal cavity. In cases of torsion there may be pure blood. In cases in which the intraperitoneal fluid might be infected the pouch of Douglas must be drained, with a Mikulicz tamponade in suppurative cysts. In 1 case, that of an infant of five months, complicating torsion of the uterus and adnexa necessitated hysterectomy. In 1 case of dermoid cyst of the ovary several smaller cysts of this type had to be removed from the pouch of Douglas. If the cyst is found to be markedly infected or adherent, marsupialization is indicated.

After-care is of prime importance in these cases; ice should be kept on the abdomen during the first days and genital hygiene, vesical care, and urinary disinfection are imperative. In cases of peritoneal reaction demonstrable during intervention, ice, rectal drop infusion, and cardiotonics are indicated. Shock following operation developed in 4 cases, ending fatally in 2. Hyperthermic pallor was noted in only 1 case, that of a child of six years who recovered. Among other postoperative complications may be mentioned postoperative collapse, convulsions, repeated vomiting, a meningeal syndrome, and parotitis.

The menstrual disturbances following the removal of ovarian cysts vary greatly. Menstruation may be precocious or irregular. Changes in the secondary sex characters have been described, such as arrested development of the breasts or hair. One girl of ten years of age at the time of operation for ovarian cyst went through a normal labor and delivery six years later. The development of stubborn constipation and intestinal dysfunction have been reported as late sequelæ.

In regard to the mortality rate, no information could be obtained as to the outcome in 60 of 195 cases. In the remaining 135 cases the results were as follows:

	Cures	Deaths
Ovariotomy for simple cyst	53	6
Ovariotomy for cysts with torsion	64	2
Ovariotomy for ruptured cyst	2	4
Ovariotomy for suppurating cyst	3	1

EDITH SCHANCHE MOORE.

Luzuy: A Virilizing Tumor of the Ovary (Tumeur masculinisante de l'ovaire). *Mém. l'Acad. de chir.*, Par., 1939, 65: 26.

The case presented constitutes the first case of virilizing tumor of the ovary to be reported by a French surgeon. About 30 cases have been collected from the world literature during the past ten years. The patient, a girl of sixteen years, was admitted for amenorrhea of two years' duration which was accompanied by progressive virilization. Up to the age of fourteen years, the menses having begun at the age of ten and one-half years, the patient had the appearance of a very robust girl. At this age amenorrhea developed and resisted all attempts at treatment. Six months after the onset of the amenorrhea, hair appeared on her face and chest, her voice became rough, her disposition irritable, and her mentality retarded. No change was noted for the next eighteen months. Examination revealed an elongated clitoris (4 cm.), a normal vagina, and a small uterine sac. The body of the uterus was not palpable. The ovarian tumor could not be palpated. Exploratory operation revealed an infantile uterus, a small left ovary of the size of a cherry, and a tumor of the right ovary of the size of an orange. The right tube and ovary were removed and the patient made a smooth recovery. Five weeks after the operation a normal menstruation occurred, and the periods had occurred regularly thereafter, according to the patient when she was seen again seven months later. Her appearance regained its feminine character, the excessive hair disappeared almost completely, the breasts developed, and the body became more feminine. The clitoris diminished to two-thirds of its former size. The voice remained slightly deep.

Histological examination of the tumor revealed an arrhenoblastoma. The characteristic symptoms as illustrated in this case are discussed.

Hitherto the interventions practiced have been usually ovariotomy, and occasionally hysterectomy. Roentgenotherapy proved futile in a case reported by Zathmary. Varangot has collected 29 cases in addition to the 31 mentioned here, but it has not been demonstrated that all were authentic.

The theories of the pathogenesis of these tumors promulgated by Meyer, Krock, and MacLester are enumerated. They are all merely hypotheses, however; all that is actually known at present is that certain ovarian tumors of typical or atypical testicular structure present the peculiar clinical and endocrinological feature that they produce virilization, which disappears after removal of the tumor.

EDITH SCHANCHE MOORE.

Delascio, D. J., and Dellivenneri, A.: Pyosalpinx Rupture (Ruptura de pyosalpingeo). *Rev. de obst. e ginec. de S. Paulo*, 1938, 3: 225.

A pyosalpinx may rupture into the colon, rectum, bladder, uterus, vagina, anterior abdominal wall, or the free peritoneum. The authors consider only rupture into the peritoneum. Rupture of a pyosalpinx is a rare accident, in which the age of the patient

does not seem to play an important causative part, although it occurs more frequently during the third decade, the usual beginning of the sexual life in woman. Traumatism (due to coitus, propedeutic and abortive maneuvers, direct trauma of the abdominal wall, strong purgatives, and physical exercise) and pathological change in the tubal wall are the determining factors of rupture. The former causes real rupture, which is hardly ever accompanied by serious peritonitis, while the latter causes perforation, which is nearly always accompanied by lethal peritonitis. Infection of the tube may occur through either opening, or by the lymphatic or the circulatory route. The gonococcus accounts for infection in 75 per cent of the cases; the streptococcus, tubercle bacillus, typhoid bacillus, and pneumococcus follow in the order of frequency as causative agents of the infection. Beginning as an acute catarrhal inflammation, the disorder may become purulent and ulcerating, and the inflammatory process may close the two tubal orifices and cause hydrosalpinx, hematosalpinx, or pyosalpinx. In the presence of rupture of a pyosalpinx, the other tube is usually affected also. The rupture occurs generally in the ampullar portion and, although usually unilateral, may be bilateral.

The symptoms of rupture are violent, syncopal pain, vomiting, high fever, filiform pulse, and marked abdominal defense. Gynecological examination causes great pain on exploration of the cul-de-sac of Douglas and a decrease in size or the disappearance of the previously found lateral tumor. The course of the rupture may be divided into a period of shock, a period of relative quiescence, and a period of generalized peritonitis. The peritonitis appears usually about the eighteenth hour after the accident. The diagnosis is not easy, but careful anamnesis and gynecological examination will make it possible. The diagnosis includes differentiation of all the acute genital disorders of the abdomen, but principally tubal pregnancy and appendicitis. Puncture of the cul-de-sac of Douglas should never be neglected. The prognosis is serious and its gravity depends on the nature of the causal micro-organism, the time of the intervention, and the immediate cause of the perforation; peritonitis due to traumatic rupture of an old pyosalpinx of low virulence is less serious than that occurring after a few days of prodromal symptoms characterizing the aggravation of a recent pyosalpinx.

Patients with pyosalpinx observed before rupture should be subjected to absolute rest in bed and conservative treatment. In the presence of established rupture, the French, Italian, American, and Argentinian schools are in favor of a more or less radical intervention, while the German and Viennese schools recommend simple abdominal or vaginal drainage, based on conservation of the adnexa. The authors favor the latter treatment and consider two eventualities: in cases in which the diagnosis is made, they recommend vaginal drainage by means of posterior colpotomy; when the diagnosis has not been made and the accident is discovered during laparotomy, they insist on abstention from any intervention on the adnexa and favor abdominal drainage combined with vaginal drainage. They describe 1 fatal case in which the diagnosis of generalized peritonitis due to ruptured appendix was made and a ruptured pyosalpinx was found at operation and removed. Examination of the pus revealed streptococci. RICHARD KEMEL, M.D.

MISCELLANEOUS

Arey, L. B.: The Degree of Normal Menstrual Irregularity. *Am. J. Obst. & Gynec.*, 1939, 37: 12.

Some 20,000 calendar records from about 1,500 women and girls, as given in 12 different studies, have been assembled, corrected, and analyzed.

The commonest length of 8,462 cycles (furnished by 585 persons) considered as a unit, is twenty-eight days, both for girls at the age of puberty, and for adult women. The average length of all cycles is thirty-three and nine-tenths days for girls and twenty-eight and four-tenths days for women.

The commonest length of 17,652 cycles (the grand mode of the individual modes of 1,265 persons) is divided between thirty and thirty-one days for young girls and twenty-seven days for adult women. The mean length of cycle, based on individual averages, is thirty-three and six-tenths days for girls and twenty-nine and five-tenths days for women. Statements concerning grand means and modes, however, have little significance in young girls since they are so unrepresentative of the wide variability encountered. The maximum departures of individuals from their means extends from one to sixty-nine days in adults and from six to two hundred and eleven days in young girls.

The smooth frequency distribution, obtained from combining all the cycles of a group into one curve, is the result of overlapping individual irregularities and not of regular, individual performances.

The existence of favored, subordinate types of cycle length (such as three, five, six, and seven weeks), in addition to the modal type, do not appear either in the massed cycles of groups or in the records of individual performance. This is in sharp contrast to the conclusions based upon oral testimony.

In the first few years of the menstrual function the cycle length is extremely variable (seven to two hundred and fifty-six days). It can be calculated that during the period of observation employed (averaging 31 cycles per person) one-third of the 100 young girls never had a cycle that corresponded with their own means. Only 1 girl experienced her own mean as often as once in three cycles. From the menarche to the twentieth or twenty-fourth cycle, only two-thirds of the total cycles of an average individual remained within a twenty-day range above and below her mean. Yet in middle adolescence, occupied by cycles 25 to 39, the regularity improved to such an extent that, on the average, two-thirds of all the cycles kept within a ten-day range.

At the end of adolescence, during the eighteenth and nineteenth years, the variability is still further reduced. In the 35 individuals studied, two-thirds of the cycles kept within a range of plus four and four tenths days with respect to the mean.

In several hundred adults who were more than twenty-one years of age, a fluctuation of about plus two and five-tenths days, with respect to the mean, expresses the limits of variability which contain two-thirds of all cycles. Expressed differently, an average adult woman must expect one-third of all her cycles to depart more than two days from her mean cycle length.

The amount of variability shown by adults is greater than it is ordinarily believed to be. Cycles ranging from two or three weeks to seven or more weeks appear in all of the groups (seventeen to forty-nine years) from which data have been collected. In the records of more than 500 women, 27 per cent never showed their own means during the observation period, which averaged 11 cycles in length. Only 20 per cent experienced their own mean in at least one-third of their recorded cycles.

The adults, reported in detail by 11 different investigators, represent all ages, including the period from late adolescence to approaching menopause. They include American, Canadian, British, German, and Hungarian subjects, of various grades of society. In no instance did an example of perfect menstrual regularity appear over any significant period of time; this is all the more noteworthy since many individuals had previously declared themselves to be the acme of invariability. The most regular records are short ones. In a separate (unpublished) study of menstrual records extending over a period of twenty years, it will be shown that temporary successions of atypical regularity, or irregularity, may occasionally interpose themselves in a rhythm of fundamentally different characteristics. It is these unrepresentative fragments of the true record that sometimes lead to erroneous conclusions concerning an individual rhythm; even a record extending for over a year may prove to be unrepresentative.

In the face of all these facts it seems improbable that menstrual regularity, in any true sense of the word, ever will be encountered over significant periods of time. Certainly, not the slightest evidence pointing toward perfect regularity has so far been produced for even a single exceptional individual. Should such a person be found at some future time, she will constitute a true medical curiosity.

Studies on the monkey and chimpanzee disclose menstrual irregularity comparable to that of the human being. EDWARD L. CORNELL, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Sundelin, G.: Diabetes and Pregnancy (Diabetes und Graviditaet). *Nord. med. Tidsskr.*, 1938, p. 1239.

After the introduction of insulin, the frequency of pregnancy in women with diabetes was increased from 2 to 15 per cent, but it still continues to be low. Abortion is frequent; the frequency is greater the higher the blood sugar. The insulin demand is increased at the beginning of pregnancy, but toward the end it is decreased, possibly because of the activity of the fetal pancreas. Pregnancy, under normal conditions, means a burdening of the metabolic processes, and in diabetes this makes for a greater tendency toward toxemia. Polyhydramnios which, before insulin treatment, was found in about 25 per cent of the cases, is now infrequent. At about the time of birth the greater instability of carbohydrate tolerance means an increased danger; however, by the author's method, hyperglycemia and acidosis are guarded against and cases of diabetic death in childbirth are scarce. The mortality in a large number of cases was about 3 or 4 per cent, whereas earlier it was about 50 per cent at birth and in the following months. For the fetus the prognosis is not bettered to a corresponding degree. Besides abortion and premature birth diabetes mellitus often produces intra-uterine death of the fetus, the reason for which is unknown. It is thought by some to be acidosis, and by others to be hormonal disturbances. In poorly controlled cases, as before insulin, gigantic children may develop and cause difficult birth. Malformations are more frequent in the children of diabetics. In the first hour after birth a hypoglycemia develops in the child. This probably occurs because during fetal life the pancreas is hypertrophied under the influence of the increased blood sugar and after birth the increased insulin production continues under changed relationships. Hypoglycemia has probably caused most of the deaths occurring shortly after birth. The fetal mortality, if one includes the cases of death in the first hour after birth, was 60 per cent; since insulin treatment this percentage has been reduced, although it still lies between 37 and 50 per cent.

In the University Women's Clinic in Lund, from 1910 to 1936, 15 patients were treated in 22 pregnancies. Of these, only 1 was treated before insulin was used. The time between the onset of diabetes and the pregnancy varied from one to fifteen years. There seems to be a greater inclination toward fetal death when the disease has existed for a longer time before pregnancy. In 9 patients with severe diabetes, the insulin demand was determined in 16 pregnancies, not only during the pregnancy, but also for some time before and after. The patients can be divided into 4 groups: (1) with no change: 4 patients in 9 pregnancies; (2) in whom the condition became worse: 1 patient in 4 pregnancies; (3) in whom the condition became better: 1 patient in 3 pregnancies; and (4) with varying relationships in different pregnancies (3 patients). The pregnancy, birth, and puerperium therefore proceeded in the majority without notable change in the carbohydrate tolerance. Complications were few; eclampsia and polyhydramnios were not observed. In 1 case, toxemia with renal insufficiency, coma, and premature birth occurred and were followed by rapid recovery from the kidney malady. In 1 case, on account of toxemia, cesarean section with sterilization was undertaken. In 2 cases versions were done. The puerperium was afebrile even after intra-uterine intervention. The mortality for the mothers was 0, for the fetuses 45 per cent (4 abortions, 4 still-births, and 2 deaths shortly after birth). A gigantic child was born in 1 case, and a malformed child (acrania) in 1 case.

If a diabetic case becomes worse (acidosis) in spite of expert treatment during pregnancy, or if another serious disease is present, the pregnancy must be interrupted, and sterilization performed as well. As parturition is approached, one must be especially attentive to changes in the sugar tolerance. Since, however, the birth itself represents only a slight risk, cesarean section should not be used except in special cases, as, for example, in giganticism. At Lund, when general anesthesia was contraindicated in cesarean section, spinal anesthesia or local anesthesia of the abdominal wall were used instead. In simultaneous sterilization this procedure was supplemented by infiltration of the specially sensitive cornual portion of the fallopian tube.

(Axel Olsen). Ronald R. Greene, M.D.

Lantuéjoul and Merger: Cardiopathy and Pregnancy: the Indications for Surgical Intervention (Cardiopathie et grossesse: les indications de l'intervention chirurgicale). *Gynéc. et obst.*, 1938, 38: 401.

Since January, 1935, Lantuéjoul and Merger have found it advisable to intervene surgically in order to avoid labor or the evolution of pregnancy in 21 pregnant women suffering from heart disease. In all but 2 cases, sterilization was performed as a complementary procedure. The intervention took place near the end of pregnancy in 7 cases and at the beginning of pregnancy in 14 cases. Local anesthesia was used when the functional condition of the patient was grave; in ordinary cases, spinal or general anesthesia served the purpose.

The 21 cases are divided into 3 groups. In the first group of 7 cases the uterus was emptied because of cardiac accidents endangering the life of the patients:

1. Near the end of pregnancy in 4 of 5 cases, including 1 of Pott's disease, the abdominal route was

used, and in the fifth case the vaginal route. All of the children and 4 of the mothers survived, the remaining mother dying of asystole on the sixth day after the intervention.

2. One of 2 women with severe cardiopathy who were delivered before the fetus was viable died of cardiac insufficiency four days after the intervention; the other died three years later from an unknown cause.

In the second group the uterus was emptied during the first months of pregnancy because of grave cardiac decompensation, the aggravation of which coincided with the evolution of the pregnancy (5 cases). The functional symptoms which were considered alarming were decubitus dyspnea, hemoptysis, aggravation of the cyanosis, and disturbances of the rhythm (extrasystoles, tachycardia, and, especially, total arrhythmia). One of these patients died on the seventh day after the intervention without showing signs of infection.

In the third group the uterus was emptied because of less decompensated cardiopathies which, however, were considered too serious to permit the evolution of pregnancy, the occurrence of labor, or the possibility of subsequent pregnancies (9 cases); in 7 cases the intervention took place before the fetus was viable and in 2 cases near the end of pregnancy.

In cases of this type the decision rests with the cardiologist, and the elements of surgical indication include various considerations, such as the actual functional condition of the patient and the eventual aggravation since the beginning of pregnancy (after a period of rest and medical treatment have been tried), the study of behavior of the heart during previous pregnancies, the physical findings, the roentgenological study of the heart and, at times, electrocardiography. The operative sequels were good in these 9 cases. RICHARD KEMEL, M.D.

Bartholomew, R. A., and Colvin, E. D.: Diagnosis of the Occurrence of Toxemia of Pregnancy by Examination of the "Unknown" Placenta. *Am. J. Obst. & Gynec.*, 1938, 36: 909.

Placental infarcts of the more acute types are definitely associated with toxemia of pregnancy. The hypercholesteremia of pregnancy is the basis for vascular changes in the placental arteries which predispose to infarction. Hypothyroidism and a diet rich in cholesterol-containing foods are important factors in excessive hypercholesteremia. The trauma of fetal movements on the placental arteries in the latter part of pregnancy is not only a predisposing cause of localized cholesterol change in the vessels but also an exciting cause of thrombosis or rupture at the site of such change, with resulting infarction.

The high content of arginin in placental tissue is the probable explanation of the specific eclamptogenic character of placental autolysate, through the formation of guanidine. The known pathological effects of guanidine, peptone, and histamine apparently explain the clinical and pathological manifestations of toxemia of pregnancy.

The results of a gross examination of 100 placentas from both toxic and normal cases, as "unknowns," without knowledge of the clinical history, shows that it is possible to diagnose the occurrence of severe toxemia in 90 per cent of the cases. Conversely, it is possible to predict the type of infarcts that will be found in the placenta from a knowledge of the clinical history of the pregnancy as to toxemia.

With the experience of examining placentas as "unknowns," it has been found possible to establish criteria for an exact classification of placental infarcts and their relation to toxemia. The 8 types of infarcts are described and illustrated by color plates. Further study of the effects of cholesterol and the biochemical aspects of placental autolysis will clarify many of the clinical and pathological manifestations of toxemia of pregnancy and will undoubtedly throw considerable light on the subject of hypertension and arteriosclerosis. EDWARD L. CORNELL, M.D.

Andérodias, J., and Péry, G.: Indications for Low Cesarean Section in Amniotic Infection (Les indications de la césarienne basse dans l'infection amniotique). *Rev. franç de gynéc. et d'obst.*, 1939, 34: 1.

Andérodias and Péry note that amniotic infection cannot occur until after the rupture of the membranes; if the fetus is living, the infection does not become very severe, but if the fetus dies the amnion becomes "a veritable culture medium," and the infection may rapidly become very severe. Three clinical types of amniotic infection are distinguished:

1. A mild type in which the temperature is slightly elevated (from 37.5° to 38° C.) and the patient has been in labor for some time and has been subjected to several vaginal examinations, possibly before admission to the hospital. If rapid delivery *per vaginam* is impossible, low cesarean section is indicated.

2. A moderately severe type with a temperature of from 38° to 39° C. and definite signs of infection, such as rapid pulse and fetid discharge. Even if the fetus is dead, low cesarean section may be done, especially in primiparas in whom conservation of the uterus is desirable, if there is no formation of gas in the uterine cavity.

3. In the severe type of amniotic infection, the fetus is dead, the discharge is fetid, the fever is high, the pulse rapid, chills may occur, and the patient's general condition is poor. In such cases a high cesarean section followed by hysterectomy, or hysterectomy *en bloc*, is indicated.

In 83 cases of amniotic infection of the less severe types (Types 1 and 2) in which the temperature was above 37.5° C., and in which low cesarean section was done there were 5 deaths, 2 from septicemia and 1 from peritonitis. In 22 cases, or 17.5 per cent, there were some puerperal complications: phlebitis (8 cases), abscess of the abdominal wall (6 cases), pulmonary symptoms (5 cases), and endometritis (3 cases). Death occurred most frequently in cases in which rupture of the membranes had occurred more than twenty-four hours before operation. Puerperal

infections occurred more frequently in patients with a temperature above 38° C. than in those with a temperature of from 37.5° to 38° C.

ALICE M. MEYERS.

LABOR AND ITS COMPLICATIONS

Wegelius, C.: The Differences Between Radiological and Anatomical Measurements in Determination of the Size of the Fetus Skull Roentgenologically. *Acta obst. et gynec. Scand.*, 1938, 18: 428.

There are two projectional errors which occur in the measurement of the pelvis and the fetal skull roentgenologically: (1) the enlargement of the picture due to beam divergence, and (2) the diminution and distortion of the picture due to the obliquity of the object to the film. So far as the pelvis is concerned the effect of these factors can be corrected satisfactorily by a variety of methods. However, in the measurement of the skull, present methods have corrected for the enlargement of the picture due to beam divergence, but satisfactory methods of correction for the obliquity have not been developed.

In order to correct the obliquity it is necessary first to determine the position of the skull, i.e., the degree of the oblique position; it is then necessary to know the percentage of the foreshortening effect of all the obstetrically important parts of the skull, in all possible degrees of obliquity. The first can be accomplished by taking a picture of the pelvic opening, which allows one to read off directly the position of the sagittal suture. If this view cannot be obtained, the determination of the position of the skull must be based upon an internal examination made as soon as possible before or after the side view has been taken. Upon the latter is based the determination of the size of the pelvis and of the fetal skull. To fulfill the second requirement, that of obtaining figures for the percentage of foreshortening in different oblique positions, the author has conducted a series of investigations. These were made upon 10 fetal skulls which had not been delivered and were all from pregnancies within two months of term. The figures determined were for the two most important circumferences, from the obstetrical point of view: the one running around the skull through the end points of the fronto-occipital and biparietal diameters, the other through the end points of the mento-occipital diameter. These were compared with the anatomical measurements. The foreshortening was calculated as a percentage of the picture measurement, which had been corrected for the divergence enlargement. This percentage gives the amount by which the picture measurement must be increased to obtain the anatomically correct size. Taking the fronto-occipital projection as 0, the skulls were rotated 180 degrees in the plane of the circumference, while the foreshortening was measured at intervals of 5 degrees. The figures, which were tabulated, show a striking similarity for the 10 skulls at similar positions. The foreshortening proved to be anything up to 20 per cent, which was sufficient to be of clinical importance. The findings are given graphically as well as in table form.

DANIEL G. MORTON, M.D.

Thoms, H.: Routine Roentgen Pelvimetry in 600 Primiparous White Women Consecutively Delivered at Term. *Am. J. Obst. & Gynec.*, 1939, 37: 101.

From this and other studies one must reconstruct the views which were previously held with regard to the architecture of the female pelvis. The incidence of the brachypellic type in but one-third of the series makes it appear that this type does not represent the norm in the adult white women of America. Studies now under way on a group of prepubescent girls have shown this type of pelvis to be relatively infrequent. It is the author's opinion that environmental influences, especially in early life and during puberty, may be of some significance in determining the configuration of the adult pelvis. In the platypellic type in this series certain sacral changes suggest that rickets probably plays a major rôle as an etiological factor.

That the dolichopellic and mesatipellic types appear to facilitate spontaneous delivery is further evidenced by the incidence of cesarean section in these two groups, 0 per cent and 0.7 per cent, respectively, while in the brachypellic and platypellic types the incidence is 4.3 per cent and 15.4 per cent, respectively. The incidence of operative intervention of all kinds in the series shows the same trend.

The routine use of simple, inexpensive roentgenological methods, especially in primiparous women at term, possesses many advantages. Not the least of these is the knowledge we are bound to gain in the treatment of cases of real and suspected disproportion. The use of the lateral roentgenogram during the test of labor makes for scientific accuracy.

EDWARD L. CORNELL, M.D.

Kuehnel, P.: The Treatment of Uterine Atony in Labor by Means of Scalp Forceps. *Acta obst. et gynec. Scand.*, 1938, 18: 466.

The use of traction on forceps attached to the scalp for uterine atony was suggested by the pains which were initiated by this procedure in the treatment of certain cases of placenta previa. Willet first described the method in 1925 and devised a suitable forceps. Since that time, 48 cases of placenta previa treated in this manner have been reported. The author has used it in 6 cases, in which all of the mothers and 4 of the babies survived.

The author believes that there is a physiological basis for improvement in contractions when traction is exerted upon the scalp. The reason suggested is the pressure exerted upon the paracervical and retrocervical tissues, which, in turn, causes irritation of the Frankenhaeuser plexus, by which pathway labor pains are elicited.

The forceps employed is nothing more than an elongated, slightly curved, double-toothed tenacu-

lum. A string tied to the handles is run over a pulley at the end of the bed, and is weighted sufficiently (with ½ to 1 kgm. of weight) to exert continuous traction.

The cases of 14 patients are reported; 8 were primiparas and 6 multiparas; 5 were non-infected and 9 infected; 5 were delivered spontaneously and 9 artificially; 12 experienced afebrile puerperia. There were 12 living children and 2 stillborn. The "bite" of the forceps healed primarily in 10 and secondarily in 4. The average age of the patients was thirty-five years. Labor had lasted an average of sixty-three hours and had varied from thirty-six to one hundred and twenty-four hours before the application of the forceps. After the forceps were applied the labors were terminated within an average of three and one-half hours, the time varying from one and one-fourth to thirteen hours.

The average size of the os when the forceps were applied was from 4 to 5 cm., the extremes being 2 and 8 cm. Pronounced uterine atony was present in all 14 cases, and in all cases other methods had been tried first with transitory effects only. No mention is made of the individual head positions. Four cases and an additional case in which the forceps were applied to the breech with a successful result are reported in detail.

Reports of the use of this method by two other observers are given; one was von Pall, the other Pannke. The former has used the method 60 times, 24 in the period of dilatation, 10 in the expulsion period, and 26 prophylactically (cases in which he wished to hasten delivery because of a complicating condition). Pannke has used the method 20 times with satisfactory results. DANIEL G. MORTON, M.D.

PUERPERIUM AND ITS COMPLICATIONS

Reich, A. M.: A Critical Analysis of Blood Loss Following Delivery. *Am. J. Obst. & Gynec.*, 1939, 37: 224.

An accurate collection and measurement of all blood loss, not only during the third stage of labor but for the necessary period of time thereafter, should be established on all obstetrical services.

Hemorrhages from lacerations in the parturient canal are often undiagnosed. The incidence and the amounts lost may be high.

Greater consideration should be given to the conduct and management of the third stage.

Post-partum hemorrhage from the normally situated placental site due to imperfect contraction of the uterus is the chief theoretical indication for an oxytocic. Hemorrhages of this origin are responsible for about 70 per cent of the cases of excessive blood loss incidental to delivery.

In a series of 588 patients treated by the administration of ergotrate after the delivery of the placenta, the incidence of a blood loss of 500 c.cm., or over, was 7.1 per cent as compared with an incidence of 16.1 per cent in 548 cases in which ergotamine tartrate was given instead. When only the blood loss after the third stage is considered, the incidence was 1.5 per cent in the ergotrate series and 11.3 per cent in the control series.

Clinical observation indicates a profound tetanic contraction of the uterus, with immediate separation of the placenta if it is still within the uterus within forty-five seconds of the intravenous administration of ergotrate. The use of the drug in 2,500 cases has been accompanied by no systemic reactions. The only complication that has been observed is the occasional retention of the placenta within a tightly contracted uterus when the drug is given at the beginning of the third stage.

Ergotrate is superior to other oxytocics, in the speed, completeness, and duration of its action, and it has a definite place in the prophylaxis and control of hemorrhage from the normally situated placental site.

Puerperal infection and other morbid processes are materially influenced and dependent on the occurrence of large blood losses. The cell volume should be restored promptly to a normal amount by the use of transfusions in sufficient amounts.

EDWARD L. CORNELL, M.D.

Beecham, C. T.: Post-Partum Hemorrhage as a Cause of Death. *Am. J. Obst. & Gynec.*, 1939, 37: 258.

The purpose of this study was to analyze the cause of post-partum hemorrhage and details of various methods of treatment as shown by the records of 52 deaths from post-partum hemorrhage in the 183,384 deliveries in Philadelphia during the six-year period from 1931 through 1936. The Maternal Welfare Committee of the Philadelphia County Medical Society judged 32 (61.5 per cent) of these deaths as preventable. The responsibility for 28 deaths (53 per cent) was assigned to the attendant, as treatment in all was deficient. Four (7.5 per cent) of the fatalities were due to ignorance of the patients, while 20 (38 per cent) were termed non-preventable. Forty-one (79 per cent) patients in this series were delivered in hospitals, while 4 (7.6 per cent) of those delivered at home were taken to the hospital after the complication had developed.

The incidence of spontaneous delivery in this series of cases with post-partum hemorrhage was 42.3 per cent; the average incidence is 72 per cent. The incidence of version (15.4 per cent) in this series was ten times as high as the average incidence of version (1.52 per cent) in the hospital deliveries of Philadelphia in the first three years of this study.

The average time between delivery and death of the mother from hemorrhage was five hours and twenty minutes, yet only one-half of the women were packed and less than one-third had blood transfusions. Very few cases indicated anything but a haphazard plan of treatment. Accepted steps in the treatment of post-partum hemorrhage are outlined, all of which are within the scope of any modern hospital and staff.

EDWARD L. CORNELL, M.D.

Kahanpää, V.: Early and Late Puerperal Morbidity, Especially Following the Retention of the Fetal Membranes and the Placenta, or Remains of the Same (Ueber Frueh- und Spaetpuerperale Morbiditaet, insbesondere nach Retention von Eihaeuten und Placenta oder Resten Derselben). *Acta Soc. med. Fennicae Duodecim*, 1938, Ser. B, 25: Fasc. 3.

The aim of the author is to throw some light on the total puerperal, inflammatory morbidity. Even the very slightest early puerperal disturbances were carefully studied in this regard and follow-up investigations and examinations were carried out to determine the condition of the women after their discharge from the hospital. The interest in the examination centered upon the different complications of the puerperal period, and special attention was paid to the retention of fetal membranes, which are generally considered insignificant.

The clinical material included 5,084 timely and premature births through the natural passages. In this investigation a morbidity scale was used, which was based upon both the different grades of fever and other symptoms. The slightest grade of disease was taken to be the group of "lochia putrida," in which only a foul-smelling lochia is a sign of puerperal morbidity. The follow-up investigations were done on 1,000 deliveries. The material for the follow-up examinations consisted of 738 of these cases, in which a gynecological examination was made, on an average of five and five-tenths years after the corresponding delivery. All the conclusions drawn from these findings were certified with the aid of mathematical-statistical probability calculations.

The frequency of retention of the fetal membranes proved to be relatively low, namely 2.5 ± 0.2 per cent. The cases of non-operative retention also showed a high early puerperal morbidity: 7.6 ± 2.3 per cent, 26.5 ± 3.8 per cent, and 52.3 ± 4.4 per cent, according to whether the morbidity was calculated on the basis of the more or less severe cases of endometritis, or whether the cases of "lochia putrida" were also included. The morbidity of the control material, that is, in cases without the complication of retention of the fetal membranes, amounted to 0.8 ± 0.2 per cent, 4.0 ± 0.5 per cent, and 13.4 ± 0.9 per cent.

The cases of retention of placental tissues (71), by their frequency, morbidity, and mortality values, support the therapeutic principles of Zangemeister. In order that the late retentions associated with a bad prognosis may be avoided, the uterine cavity should be explored immediately after delivery in all cases, including even those in which retention is barely suspected. An average of thirteen days elapsed up to the time of the hemorrhage that indicated the exploration in the puerperium, which is a longer time than is generally reported.

The material includes 355 cases of manual separation, the frequency of which was 0.99 ± 0.05 per cent. The number of fatalities was 16, the total mortality therefore amounting to 4.5 ± 1.1 per cent. If the patients who died from other causes than the retention (8), from hemorrhage as a result of delayed manual separation (4), and from criminal abortion (1) are not included, the true mortality from manual separation amounts to 0.8 ± 0.5 per cent. This material is also classified with regard to retention of the fetal membranes, following separation of the placenta. It was found that this additional complication considerably increases the morbidity of the cases of manual separation; in fact it causes more morbidity than any other intervention made in connection with retention.

The follow-up examinations showed that even in cases in which the labor and early puerperium ran a perfectly "normal" course, a late morbidity occurred; in spontaneous births with completely expelled placentas and absolutely asymptomatic early puerperiums, the late morbidity amounted to about 4 per cent. In the group "lochia putrida," the late morbidity was considerably higher (17 ± 3.4 per cent) and approached that of the cases of true endometritis (24 ± 5.3 per cent). In the cases of retention of the fetal membranes the late morbidity was also high, but in the cases of manual separation they were lower than could be expected. It appears that follow-up investigations alone generally did not suffice to definitely show a post-partum inflammation of the genitalia, but that an objective follow-up examination was necessary.

The early and late morbidity of the cases of retention of the fetal membranes compels us to take this complication seriously. The prophylaxis, namely, the proper management of the puerperal period, must become more effective. In addition, an effort should be made to find the least harmless remedy for the removal of the remains of fetal membranes immediately after the delivery. We should abandon the overvaluation of the danger of manual separation in order that this intervention may be made early enough in the therapeutic program, especially in cases of hemorrhage. The high late morbidity in the cases of "lochia putrida" shows that a foul-smelling lochia in the early puerperium usually shows the presence of a true inflammatory process in the uterine mucosa, even in the absence of fever. In these cases the hospital treatment must be prolonged and suitable after-treatment must be given. All parturient women should be examined a few months after the delivery, so that diseases appearing later can be properly treated in time and the resulting prolonged or remaining inflammations, with all their serious results, can be diminished.

LOUIS NEUWELT, M.D.

Balard, P.: Personal Experience with Puerperal Peritonitis (Mon expérience personelle des péritonites puerpérales). *Rev. franç. de gynéc. et d'obst.*, 1939, 34: 18.

In the twenty-five years in which Balard has been in practice, there has been a definite improvement in the diagnosis and treatment of puerperal peritonitis. In most of the 28 cases treated between 1934 and

1938, operation was done within the first few days after the development of symptoms. Only 1 patient was not operated upon; this patient was admitted to the hospital *in extremis* and died shortly afterwards; however, another patient, also admitted *in extremis*, was operated upon and recovered.

Of the 28 cases of puerperal peritonitis reported, 16 occurred after abortion, the remaining 12 after delivery at term. At operation an incision was made in the lower portion of the abdomen and drainage was established; in most of the author's cases a Mikulicz drain was used. While hysterectomy may appear to be a logical procedure in these cases, Balard is of the opinion that it involves too great a shock and is attended with a high mortality. Hysterectomy was done in only 1 of his cases, and the patient died. Of the 16 patients in whom peritonitis developed following abortion, 12 died and 4 recovered. Of the 12 patients in whom peritonitis developed following delivery at term, 6 died and 6 recovered. The cases of peritonitis developing after abortion were of a more severe type than those developing after delivery at term, and the peritonitis was more frequently secondary to a septicemia than due to direct extension from the infected uterus. In cases of abortion of the criminal type, also, the patient is less likely to be under constant medical supervision, and the diagnosis of peritonitis is not made promptly.

In 20 cases in which bacteriological examination was made, the streptococcus was the organism most frequently found. In 7 cases, the non-hemolytic streptococcus, and in 6 cases the hemolytic streptococcus was found; in 3 cases the streptococcus was associated with other organisms.

ALICE M. MEYERS.

NEWBORN

Reuss, A. von: On the Pathology of Newborn Infants (Zur Pathologie des Neugeborenen). *Arch. f. Gynaek.*, 1938, 166: 426.

Infant mortality is today, according to von Reuss, primarily a problem of early death due to a series of physiological peculiarities of the infants. To these belong the allergies, of which the most frequent expression is called erythema toxicum neonatorum. Recurrent exanthema is considered an early sign of an exudative diathesis. Von Reuss also interprets certain types of melena disease or enterospastic conditions as expressions of allergy. Icterus gravis is nothing but a somewhat pathologically heightened icterus neonatorum. A palpable spleen and numerous erythroblasts in the blood stream suggest unfavorable prognoses. Therapeutically, blood transfusions are superior to other methods of management. A dehydration beyond the normal physiological weight loss is often expressed in a flaccid, wasted appearance, apathy, and, less often, in a restlessness. This condition requires compensation for the fluid loss. The author recommends the administration of tea and Ringer's solution in equal parts with the addition of from 5 to 10 per cent sugar. By means of this treatment the water retention is improved and acetonemia and hypoglycemia are prevented.

The diagnosis of "tetany" can only be made in an infant when there is a lowering of the serum calcium, an increase in the serum phosphorus, and an alkalosis. The typical melena neonatorum has nothing to do with sepsis; the best therapeusis is a blood transfusion. Von Reuss emphasizes especially that from 50 to 100 c.cm. of blood must be transfused into a bared vein as the popular method of injecting small amounts of blood, from 15 to 20 c.cm., into the longitudinal sinus is usually without result. The great sensitivity of the skin and the high degree of contagion in pemphigoid diseases are pointed out. The most malignant form of the latter is exfoliative dermatitis. Fortunately, congenital lues is implied to be on the decline. For its eradication examination and treatment of all pregnancies during the first months are necessary. If a woman is found to give a positive reaction to the serum test during the puerperium, prophylactic antiluetic treatment of the child must be undertaken.

In conclusion, the author points out the importance of adequate care of premature children, especially of the maintenance of a constant temperature

(VON JASCHKE). RONALD R. GREENE, M.D.

GENITO-URINARY SURGERY

ADRENAL, KIDNEY, AND URETER

Reilly, W. A., Lisser, H., and Hinman, F.: Pseudosexual Precocity: The Adrenocortical Syndrome in Pre-adolescent Girls. *Endocrinology*, 1939, 24: 91.

The symptoms and signs produced by adrenocortical endocrine tumors (hyperplasias, adenomas, or malignancies) vary according to the sex and age of the patient. If such a tumor arises during intrauterine life, pseudohermaphroditism results; if it occurs in a little boy, sexual precocity develops with genitalia of adult size and corresponding secondary sex characteristics; if the adult male is affected, gynecomastia and, perhaps, even lactation and other evidences of feminization appear; the adult female is masculinized (so-called virilism or hirsutism), and amenorrhea, heterosexual hypertrichosis, an enlarged clitoris, and atrophy of the mammary tissue develop. When a little girl is afflicted by such a tumor, however, pseudosexual precocity occurs, the outstanding characteristics of which are the very early appearance of pubic hair and hypertrophy of the clitoris, which causes it to resemble a small penis.

Pineal, testicular, and cerebral tumors in a boy can cause sexual precocity which is very similar to that produced by an adrenal tumor. Eunuchism can account for gynecomastia in a man. Cushing's disease of the pituitary body, arrhenoblastoma of the ovary, or oat-cell tumor of the thymus can cause masculinization of the adult female difficult to distinguish from the virilism caused by an adrenal tumor. No other lesion, however, seems capable of imitating the clinical picture seen in a little girl with an adrenocortical tumor. It should be emphasized that the sexual precocity caused by a granulosa-cell tumor of the ovary is by no means the same as that caused by a tumor of the adrenal cortex. In these tumors of the ovary, the internal genitalia are those of an adult female, and early menstruation takes place (at from one to five years of age); but enlargement of the clitoris does not occur. Instances of menstruation or vaginal bleeding before the age of eleven years are exceptional, but have been recorded in association with tumors of the adrenal cortex. Because of these important distinctions, the term "pseudosexual precocity" (Lisser) is used to describe the clinical picture seen in little girls with adrenocortical tumors, which is a condition different from "true sexual precocity" caused by granulosa-cell tumors of the ovary which produce the female sex hormone in excess.

As a rule, adrenocortical endocrine tumors are encapsulated for some time, which fact aids materially in successful surgical removal. Later on, as malignant changes progress, metastases take place, usually to the lungs, liver, and spleen; hence, early diagnosis and operation are important.

Forty cases have been tabulated and divided into 4 groups:

Group 1. Division A of this group included 10 cases in which operation was performed successfully. In 7 of these, an adrenal tumor composed of cortical tissue was removed; in the remaining 3 (the cases of Hugh Young) partial suprarenalectomy was performed for bilateral hyperplasia of the adrenal cortex. Division B included 3 cases of aberrantly situated adrenocortical tumors which were successfully removed. In each of these the tumor was in the pelvis, either attached to, or imbedded in, an ovary.

Group 2 consisted of 10 cases in which a tumor of the adrenal cortex was removed. The patients died either during operation or within three days thereafter.

Group 3 consisted of 2 cases in which exploratory laparotomy was performed. In one of these, a large tumor of the right adrenal body was considered inoperable; autopsy was performed nine months later. In the other case, no tumor was found; suprarenal hyperplasia was suspected, but no tissue was removed. There was scarcely a question in the diagnosis in this case, as all the conspicuous clinical characteristics of the syndrome were present.

Group 4 included 15 cases in which no operation was performed, but in which tumors of the adrenal cortex were found at autopsy.

For some reason which the authors are unable to explain, about 65 per cent of the tumors occurred on the left side.

The sizes of the tumors varied. Descriptive terms, such as size of apple, goose-egg, small cocoanut, two fists, child's head, kidney, and man's head, were used. The weight of the tumor varied from 10 gm. to 2,000 gm., and from 1½ lb. to 3 lb., 13 oz.

Usually, this type of tumor is surrounded by a tough, fibrous capsule attached to a pedicle, which helps materially in surgical removal. The shape of the mass may be irregular, but tends to be roughly spherical. On section, the tumor may prove to be entirely solid or partly cystic, as a result of hemorrhage or degeneration. Grossly, the section may be of a brownish-yellow color.

In 29 of the 40 verified cases, a description of the microscopic appearance of the tumor was available. Eight of the tumors were considered malignant. In 9 cases in which the authors failed to obtain microscopic data, malignancy was obvious because metastases were mentioned. In other words, fully one-half of the tumors showed malignant change. Despite the presence of malignancy, operation seems to have been successful in 2 instances. However, neither of the patients has been observed long enough since operation to exclude the possibility of subsequent recurrence. One patient seems to be entirely well two years after removal of the tumor. Malignancy cannot be predicted clinically prior to

operation unless metastatic nodules can be felt in the liver or demonstrated roentgenologically in the lungs or in the sternum. These are the usual sites of metastases from adrenocortical tumors.

The cytological picture may be that of adenoma or hyperplasia of the adrenal cortex, and the majority of the tumors seem to originate in the zona fasciculata. The predominant cell type is of large polyhedral shape.

The term "hypernephroma" is used frequently in characterizing this tumor. Although this designation is correct, the phrase "tumor of the adrenal cortex" would be more accurate and less susceptible to misunderstanding.

From a clinical standpoint it seems almost inevitable that some of the other endocrine glands must be involved secondarily. An antagonistic effect on the ovaries is inescapable. Stimulation of the anterior pituitary gland and, perhaps, the thyroid, is suggested by the relative tallness and advanced ossification of these patients for their age. The autopsy reports, however, yield very fragmentary and insignificant information concerning pathological alterations in the other parts of the hormonopoietic system. The pituitary body was said to be normal in 2 cases and an eosinophilic adenoma, a colloid cyst and atrophy, and cystic hypoplasia, respectively, were found in 1 case each. It is difficult to interpret these findings, especially in view of the intimate functional relationship between the adenohypophysis and the adrenal cortex. No pathological changes were found in the thyroid gland. The ovaries were considered normal in 2 cases, and infantile in 1 case, and the authors described them as "progeric." The pineal gland was enlarged in 1 case. Far more thorough and elaborate studies of the ductless glands are necessary in future autopsies before any reliable conclusions can be formed as to the secondary effects of these tumors of the adrenal cortex.

From a technical standpoint, adrenalectomy on the right side is more difficult than on the left, because of the shorter pedicle of blood vessels. The right adrenal body lies very close to the inferior vena cava. In 7 of the 10 cases which were successfully operated on, an adrenal tumor was removed from the left gland; in 3 cases, partial bilateral adrenalectomy was performed for bilateral suprarenal hyperplasia. The 3 aberrant adrenal tumors which were successfully removed presented a simpler technical problem (2 of these involved the left ovary, and 1 the right). In contrast, it is interesting to note that in 6 of the 10 cases in which the patients died shortly after operation, the tumor was situated in the right adrenal gland. These fatalities, however, were not ascribed to loss of blood.

When the diagnosis is definite and the side to be operated upon is known, the direct retroperitoneal approach for the lumbar incision (in common use in renal surgery) is most satisfactory. Free division of the costovertebral ligament permits easy retraction of the twelfth rib, resection of which is then unnecessary. After the upper pole of the kidney is freed, this organ can be pushed down out of the way and the adrenal area is then fully exposed. The technique used in the freeing of the adrenal tumor (which is usually well encapsulated) is very similar to that followed in surgery of the kidney: blunt dissection, clamping, and ligation of the pedicle.

When there is doubt regarding the side to be operated on, or bilateral involvement is suspected, an operative procedure which will permit exposure of both adrenal areas at once is far superior to a two-stage operation, whether it is performed at the same time or at different times. If neither adrenal body shows a definite tumor it may be advisable to resect portions of both glands, and the extent to which the resection should be carried is more accurately determined if both glands have been inspected before the resection of either. Bilateral exposure through a midline abdominal incision is simple and satisfactory, but subsequent procedures—either partial resection or total adrenalectomy—are more difficult than if exposure is made retroperitoneally. For this reason the use of right and left lumbar incisions, with the patient flat on the abdomen, has advantages. This position was formerly used for bilateral nephropexy and was often preferred even for unilateral surgery by Kidd. Recently, it was used by Young in 3 cases of partial bilateral resection. When bilateral inspection through these lumbar incisions reveals a tumor of one adrenal body, and the other is normal, the patient can be placed in the kidney position for retroperitoneal removal of the involved gland, if desired.

ELMER HESS, M.D.

Levy, S. E., and Blalock, A.: A Method for Transplanting the Adrenal Gland of the Dog with Re-establishment of Its Blood Supply. *Ann. Surg.*, 1939, 109: 84.

Prompted by a determination to study the effect of removal of one adrenal gland and denervation of the remaining one on experimental hypertension due to renal ischemia, the authors describe and submit their findings in transplantation of the adrenal gland to the neck in dogs. It is stated that search of the literature reveals no instances in which the gland has been transplanted *in toto* with the re-establishment of its blood supply by suture of the blood vessels.

Transplantation of the adrenal gland to the neck of dogs, it was felt, offered certain advantages in subsequent studies: it represented a denervated preparation, the venous return was through the external jugular vein which is located just beneath the skin and can be punctured without difficulty, and the superficial position of the gland made it readily accessible for roentgen treatment, removal under local anesthesia, or for other procedures.

Finding that the blood vessels of the adrenal gland were too small for anastomosis by suture, the renal artery and vein of the adjacent kidney were utilized as conductors of blood to and from the transplant. The kidney and adrenal gland were transplanted *en masse*, the renal artery being anastomosed to the carotid artery, the renal vein to the external jugular

vein, and the kidney removed at a later date. Large mature dogs were used in all experiments and the length of time that the transplanted tissues were completely deprived of their circulation varied from twenty-nine to forty-two minutes in the different experiments. The operative technique is presented in detail as it was applied to 14 subjects. Seven failures were ascribed to thrombosis of the vessels, necrosis and infection of the tissues of the neck, distemper, secondary hemorrhage, or to adrenal insufficiency.

Observations were made on the remaining 7 dogs which have lived for a number of months with a single adrenal gland located beneath the skin of the neck. Such animals maintained their weights, played and fought as do normal dogs. One became pregnant and gave birth to a normal puppy. Evidence that the transplanted gland begins to function at an early date was found in an experiment in which the right adrenal gland was removed thirteen days prior to transplantation of the left one. Evidence that the transplant will live when the second adrenal gland has not been removed was suggested by experiments in which transplantation of the left adrenal gland preceded the removal of the right one by one month.

The arteriovenous difference in oxygen of the transplant was exceedingly small, while tests for epinephrine revealed no unequivocal inhibition of the intestinal strip by venous blood from the transplant. The survival period of the one animal in which the transplant was removed for determination of the latter point was less than five days. Four transplants which have been removed and examined appeared normal grossly and microscopically, including the cortex, medulla, and surrounding ganglia. Only unmyelinated fibers were present in the transplanted adrenal gland, and material removed at autopsy from the region of the usual location of the glands did not reveal accessory adrenal tissue.

ARTHUR H. MILBERT, M.D.

Marion, G.: Atrophic Kidneys (Reins atrophiques) *J. d'urol. méd. et chir.*, 1939, 47: 5.

Marion defines an atrophic kidney as one in which the renal mass is much reduced as compared with the normal; as a rule the anatomical characteristics of such a kidney are abnormal with resultant marked reduction in function. Atrophy of the kidneys may be either congenital or acquired; the latter is more frequent.

Congenital atrophy of the kidney is a true malformation similar to that of complete absence of the kidney; both result from an embryological arrest of development. Such congenitally atrophic kidneys are of various forms and sizes. In 1 patient, recently operated on for infection and suppuration of the ureter, a nodule the size of a pea was found at the upper end of the ureter; histologically it consisted of renal tubules, the embryological origin of which is the same as that of the ureter. In another case of a large hydronephrosis, the walls of the renal pelvis and dilated calyces were very fibrous; at one point a small thickened mass was found, which consisted of normal renal tissue. In 1 case in which the urine from one kidney was much less in amount and more highly concentrated than that from the other kidney, the affected kidney at operation was found to be a kidney "in miniature," much smaller than normal in size, but of normal form and structure except that the pelvis was a small pocket with only two small calyces. Another variety of congenital atrophic kidney is that seen with a double kidney, in which the upper kidney is often atrophic with a poorly developed pelvis. It is the abnormality in the renal pelvis which distinguishes congenital from acquired atrophy of the kidney. In congenital atrophy, the pelvis and calyces are never normally developed; either they are reduced in size or the calyces are reduced in number. The renal parenchyma in congenital atrophy may be entirely normal, or partially normal and partially fibrous; it may show only the excretory tubules and no glomeruli; or it may be the site of inflammatory processes.

Acquired atrophy of the kidney is usually due to infection. The infection may be an uncomplicated pyelonephritis, but as a rule, this is associated with the presence of a calculus. Tuberculosis does not produce atrophy of the kidney unless there is some associated infection. Infarction may also cause atrophy of the kidney. Acquired atrophy of the kidney is usually total, but it may be partial. In total atrophy, not only is the organ diminished in size, but its surface is irregular; the parenchyma is diminished in thickness, but the pelvis is usually normal or slightly dilated. Histological examination shows that the inflammatory lesions resulting from the infection tend to become sclerotic with destruction of the typical elements of the renal parenchyma. In 1 atrophic kidney resulting from subacute pyelonephritis, the glomeruli were largely transformed into fibrous bands, the tubules being relatively less involved, while in another atrophic kidney, associated with calculus, the tubules were largely obliterated by hyaline substance, the glomeruli being less involved; in a third case both tubules and glomeruli were markedly altered.

In some cases the presence of an atrophic kidney may cause no symptoms. Usually, however, symptoms are present, but they are not characteristic. One of the most frequent symptoms is pain of the type of renal colic. The urine is usually purulent; occasionally there may be blood in the urine. The history usually shows evidence of a chronic pyelonephritis or of a calculus (sometimes an operation has been performed for calculus). Sometimes the roentgenogram shows the presence of a calculus, and when the patient comes to operation the renal atrophy is discovered and nephrectomy is done. In other cases ureteral catheterization and the analysis of the separate urines shows that the urine from the affected kidney is less in amount and the urea concentration is diminished; the phenolsulfonphthalein excretion is also diminished as compared with that of the opposite kidney. If, with these findings, the pyelogram shows a normal renal pelvis, or an ab-

normally small pelvis with diminution in the number of calyces, one may make the diagnosis of renal atrophy, either acquired or congenital, depending on the appearance of the pelvis. The only case in which the renal pelvis shows any abnormality in the pyelogram of an atrophic kidney of the acquired type is that in which a nephrostomy has been done previously for removal of a large calculus.

Renal atrophy is not a serious condition *per se*, but it may have serious consequences if the opposite kidney becomes the site of a lesion that would require nephrectomy, such as tuberculosis or tumor; or if an operation is indicated which would suppress the function of the opposite kidney for a time, such as nephrostomy for calculus. When renal atrophy produces symptoms, the atrophied kidney should be removed; if it causes no symptoms and is discovered only incidentally, nephrectomy is not necessary.

ALICE M. MEYERS.

Higgins, C. C.: Squamous-Cell Carcinoma of the Renal Pelvis. *Arch. Surg.*, 1939, 38: 224.

Five cases of squamous-cell carcinoma of the renal pelvis, seen at the Cleveland Clinic, are added to 59 already noted in the literature. Difficulty is encountered in the analysis of these cases because of the varied terminology used to describe the pathological picture. Complete reports are given of these 5 cases.

From an etiological standpoint, one finds that renal calculi, long-continued chronic inflammation, and leucoplakia are the predominating precursors of squamous-cell carcinoma of the renal pelvis. Of interest are the epithelial changes, reported by Wolbach and also by the author, occurring in the presence of Vitamin-A deficiency. In rats and guinea pigs, it was noted that the epithelium of various organs, including those of the urinary tract, was replaced by a stratified keratinizing type similar to, or comparable with, leucoplakia.

In the majority of the reported cases, the lesion occurred in patients in the fifth decade of life, the average age being fifty-six years. In the present series, the ages were forty-one, fifty-two, fifty-one, forty-nine, and fifty-eight years. Of the 64 patients whose cases were reported, 36 were males and 28 were females. The site of predilection of the tumor was about evenly divided between the right and left sides in the collected series, while in the present series the right kidney contained the tumor in 4 instances, and the left kidney in 1.

No definite symptoms are pathognomonic of the condition, and often the symptoms are referable to a coexisting calculus. While it has been said that hematuria rarely occurs with this type of tumor, because of its relative avascularity, Higgins noted hematuria in all 5 of his cases. Each of his patients manifested pyuria with its associated symptoms. Loss of weight is a late manifestation, occurring after metastases have developed.

While early diagnosis is essential, it may be difficult, even when all available facilities are employed. The condition must be differentiated from tumor involving the renal parenchyma, from non-opaque calculi in the renal pelvis, and from early renal tuberculosis. Pyelography is the most important means of establishing a diagnosis, but the filling defect must be differentiated from that produced by calculus or tuberculosis. Occasionally, the presence of a calculus may mask the true condition.

The most common coexisting pathological conditions are leucoplakia and renal calculi. A chronic inflammatory process is often present and hydronephrosis and pyonephrosis have also been noted in several instances. Two types of lesion predominate: (1) lesions in which the tumor cells invade the renal parenchyma early and eventually replace it; (2) lesions confined chiefly to the renal pelvis, often taking on a papillary appearance and causing ureteropelvic obstruction. Metastases occur early and are widespread, dissemination through the blood stream being evidenced by lesions in the lungs, liver, and bones, and also by lymphatic extension to the regional lymphatic glands.

Early diagnosis, followed by nephrectomy, is the procedure of choice. In the present series no reduction in the size of the tumor was noted following pre-operative high voltage roentgen therapy. Post-operative roentgen-ray therapy is advisable. Diagnosis is frequently not established until late in the course of the disease, and metastases may be present when the patient first consults the physician.

The prognosis is grave because of the frequency of metastasis. In a review of the literature, the author was unable to find the report of a patient who was free from metastases at the end of five years. Kretschmer, reporting on 30 instances of operative intervention, noted an operative mortality of 53.3 per cent. The average duration of life was seven months and fifteen days. In this series, 1 patient died from bronchopneumonia twenty-eight days after operation, a second died five months after operation with metastases in the lungs; the third died from generalized metastases one month after operation; the fourth patient is living and well three years and eight months after operation, with no evidence of metastasis; and the fifth patient died of metastases two years and nine months after operation.

ARTHUR H. MILBERT, M.D.

GENITAL ORGANS

Fèvre, M., and Eck, R.: A Clinical and Therapeutic Study of Ectopia of the Testicles (Étude clinique et thérapeutique de l'ectopie testiculaire). *Ann. méd.-chir.*, Par., 1938, 3: 339.

Fèvre and Eck note that ectopia testis may be unilateral or bilateral (monorchidism or cryptorchidism). The appearance of the scrotum usually draws the attention of the parents to the abnormality. Diagnosis is made by careful palpation of the iliac fossa and along the inguinal canal, with the child lying down. Palpation is done gently and slowly with the fingers pointed downward along the ingui-

nal canal. The testicle is often felt as a small mobile mass, sensitive to pressure, in the inguinal canal, and it may be possible to push it down outside of the canal. Sometimes the testicle may be fixed in the inguinal canal; such testicles are always small, often soft, and usually very sensitive. If the testicle is not found in the inguinal canal, the neighboring regions should be carefully palpated. The testicle may be absent, but in some cases, even when not palpable, it may be small and situated deep in the iliac region.

Some boys with ectopia testis appear otherwise normal, both physically and mentally, but others show definite symptoms of glandular deficiency, and sometimes exhibit the adiposogenital syndrome. As the subject reaches puberty and manhood, the ectopia is often the cause of feelings of inferiority, sexual inhibition, and neurasthenia. Some men with ectopia testis are sexually potent, but others are impotent and show typical signs of eunuchism.

In the treatment of ectopia testis, it is important to determine the degree of mobility of the testicle. If the testicle is so mobile that it can be easily pushed down into the scrotum, it usually comes down normally as the boy develops without special treatment. If it is mobile, but cannot be pushed out of the inguinal canal, medical treatment is of benefit. If the testicle is fixed, or outside of the inguinal canal, or is associated with a hernia, operation is indicated. Operation is also indicated if the testicle cannot be found by palpation. It is essential that the testicles be brought down into the scrotum before the age of puberty so that their normal function may be maintained.

Medical treatment consists in the administration of gonadotropic hormone (from the anterior lobe of the hypophysis) or the male sex hormone. Lereboullet has used thymus extract with good results, but the gonadotropic or male sex hormones are more often employed; the former may be associated with thymus extract. Hormone treatment should be begun early so that if it fails after a fair trial, there is still time for operation to be done before the age of puberty. Hormone therapy has undoubtedly given good results in many cases with palpable and mobile ectopic testicles. When the testicle cannot be palpated, it may cause enlargement and descent.

Operation should be done between the ages of six and twelve years; if the testicle is mobile, hormone therapy should first be tried and operation done later. However, if the testicle is fixed and soft, shows evidence of atrophy by compression, or is painful, operation should be done at the age of six or seven years. The transscrotal procedure of Ombrédanne is employed by the authors. In 84.5 per cent of 117 cases in which operation was performed with reexamination at intervals of from several months to several years after operation, they found the testicles well descended and in good position; in 8.5 per cent the descent was not complete; in another 2.5 per cent, in which there was bilateral ectopia, one testicle had failed to descend or was atrophied. In 2.5 per cent the results were poor, and in 2 cases the results were not definitely established. After successful operation it was found that the testicles reached normal size and development, even if they showed definite hypoplasia at the time of operation. In about one-third of the cases, there was a definite improvement in the growth of the body, and in the general physical and mental condition after operation. MacCollum of Boston, Wangensteen, and, more recently, J. Schultz have published statistics showing that men who were successfully operated upon for ectopia testis before puberty are fertile in a considerable percentage of cases. ALICE M. MEYERS.

MISCELLANEOUS

Vest, S. A., Hill, J. H., and Colston, J. A. C.: Experimental and Clinical Observations on Sulfanilamide in Urinary Infections. *J. Urol.*, 1939, 41: 31.

The authors have carried on an investigation of the anti-bacterial effects of known amounts of sulfanilamide upon graduated numbers of certain of the bacteria of significance in urinary infections. They learned that sulfanilamide was a most potent antibacterial agent and that it was of value in cases in which mandelic acid proved unsuccessful. They concluded that this drug had a definite bactericidal action in urine infected with staphylococcus aureus, escherichia coli, aerobacter, and proteus.

This bactericidal action is not demonstrable in large numbers of these organisms.

It may be regularly demonstrated when the number of organisms is reduced to from 100 to 4,400 organisms per c.cm., the number depending on the genus, except when the organism is the aerobacter which is known to be more resistant than the other organisms here studied.

The greatest reduction occurs within the first eight hours, after which, if sterilization is not complete, an increase may occur.

The direct action of sulfanilamide in urine therefore follows closely the laws applicable to other directly anti-bacterial agents in that (a) the action increases directly with the dosage of the drug; (b) the action varies inversely with the number of organisms present; (c) aerobacter is more resistant *in vitro* than the other organisms studied.

The use of sulfanilamide in a series of cases such as those encountered on the surgical urological service has been discussed. The incidence of organisms present before and after treatment with moderate doses of sulfanilamide is given.

The clinical result following the use of sulfanilamide in moderate doses is in proportion, with consideration of the organism encountered, to the complicating factors. Single infections are more readily sterilized than mixed infections.

Compared with the use of mandelic acid in a similar series of cases, sulfanilamide is a more potent urinary antiseptic, even when used in moderate dosages, and even though frequently discontinued because of disagreeable symptoms.

Sulfanilamide is one of the most potent and practical urinary antiseptics that has been introduced. We believe, however, that it should not be used indiscriminately and that in cases infected with certain types of organisms other therapeutic agents are preferable. J. SYDNEY RITTER, M.D.

O'Crowley, C. R., James, W. L., and Sutton, H. L.: Sulfanilyl-Sulfanilamide in the Treatment of Gonorrhea in the Male. *J. Urol.*, 1939, 41: 51.

Following the work of Gray, Rosenthal, and Barlow, in which they reported that sulfanilyl-sulfanilamide given by mouth was one-half as toxic as and slightly more effective against streptococcic infections in mice than sulfanilamide, the authors made a clinical study of gonococcic infections in man using the related compound for therapy.

A group of 85 patients were established on a routine of 45 gr. of sulfanilyl-sulfanilamide daily, and treatment was continued until both glasses of urine had been clear for four days, unless the total amount of drug given was more than 500 gr., when it was discontinued with few exceptions. At this point provocative tests were made, and if there was no recurrence within a period of several weeks, the patient was discharged as cured. Ninety-four per cent of the patients were reported as clinically cured in an average of ten days. Seven per cent showed some reaction to the drug, but in no case was it serious. The drug in the authors' hands seemed equally effective in old and new cases, being 50 per cent more effective and 50 per cent less toxic than sulfanilamide, and an extremely low proportion of complications (1 per cent) and no recurrences were encountered.

D. E. MURRAY, M.D.

Batchelor, R. C. L., Lees, R., Murrell, M., and Braine, G. I. H.: 2-Sulfanilyl-Aminopyridine (M & B 693) in the Treatment of Gonorrhea. *Brit. M. J.*, 1938, 2: 1142.

The authors present a preliminary report of 102 cases of gonococcal infection treated with M & B 693, in which the standard of cure, the general results of treatment, and the management of a case are given. They conclude from their work that a high proportion of apparent cures can be obtained in a large majority of cases (91 per cent); they may be of short or long duration, and occur in men or in women. The complications, such as epididymitis, arthritis, or iritis, present in many of the cases when first seen, improve rapidly. In the cases reported there was complete absence of complications or spread of the disease after the start of drug therapy without irrigation or other adjuvant treatments. Toxic symptoms occurred in less than one-third of the cases in which recovery was quickly made and no lasting ill effects were encountered. When normal dosage was employed, the toxic effects were usually mild and required only a reduction of the dose. As a result of their experience, the authors are led to conclude that M & B 693 is the most potent antigonococcal agent available at the present time. D. E. MURRAY, M.D.

Wilkie, C. H.: The Treatment of Gonorrhea with Uleron: a Review of 120 Male Cases. *Brit. M. J.*, 1939, 1: 57.

The author reviews 120 cases of neisserian infection treated with uleron, which is apparently a sulfanilamide compound. He concluded that this drug gave excellent results.

He reported cures in 74 per cent of the patients who had received no other treatment and had reported in the early stages of the infection. Of a second group of 20 patients who had received treatment and resisted the ordinary forms of medication, 5, or 25 per cent, did not respond to treatment. The reaction from this drug, although 11 gr. of the drug were given over a period of three days, was not alarming. Three patients complained of a slight headache and 4 of slight nausea. Two patients developed a generalized urticaria which disappeared entirely after one week's cessation of the drug.

J. SYDNEY RITTER, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Peycelon, R.: Metastatic Staphylococcic Bony Suppurations in the Clinical Course of Furuncles and Anthrax in the Adult (À propos des suppurations osseuses métastatiques à staphylocoques au cours de l' évolution des furoncles et des anthrax chez l'adulte). *Rev. d'orthop.*, 1939, 26: 33.

Metastatic staphylococcic bone infections in the adult are relatively rare. These metastatic lesions have their primary focus ordinarily in acute pulmonary pathology, felons, or furuncles of the skin. Metastatic osteomyelitis is characterized by localization in the long bones, and in the adult it lodges in the middle of the diaphysis, while in the adolescent it localizes close to the epiphysis.

Three groups of anatomicoclinical forms are described: (1) acute osteomyelitis involving all the layers of the bone from the periosteum to the medullary cavity; (2) subacute cortical diaphyseal osteitis (this type is represented by destruction in one point of the diaphysis of very limited depth and independent of the central diaphyseal canal. To this is added a reactionary periosteal swelling. This type of lesion frequently causes difficulty in differentiation from bone syphilis or bone sarcoma.); (3) a type of metastatic periostitis which is more than a true osteitis and involves only the peripheral layer.

Six cases are described in detail, all of which gave a culture of pure staphylococcus. The bones involved in these cases were: the femur (2); the tibia (2); the fibula (1); and the iliac bone (1).

The origin of the metastatic staphylococcus has been determined definitely in each of the 6 cases presented. In each case an injury to a long bone occurred during the course of a furuncle of the skin. The metastatic lesion followed, and both the original and metastatic lesions were identified as being due to the same organism, the staphylococcus aureus.

RICHARD J. BENNETT, JR., M.D.

Mider, G. B., and Morton, J. J.: Pulsating, Benign Giant-Cell Tumors of Bone. *Ann. Surg.*, 1939, 109: 126.

Pulsating giant-cell tumors of bone are extremely rare. Only 4 cases that can be definitely identified as benign have been found in the American literature since 1900. There were no cases of this type reported in more than 300 benign giant-cell tumors listed in the bone sarcoma registry of the American College of Surgeons.

The authors present in abstract form the 4 previously reported cases and report a fifth case in detail.

The patient was a white female, aged fifty-two. Laminectomy was performed in 1924 for swelling of the spinal cord in the upper thoracic region. Roentgenotherapy enabled the patient to walk after two years.

In April, 1935, the patient first noted tenderness in the left sacroiliac region. The pain became constant and was aggravated by walking. In April, 1936, she noticed a swollen, painful area. Two months before admission there were numbness and tingling in the feet. She experienced a "crackling" sensation at the site of the tumor.

Physical examination revealed a smooth, rounded, soft, fixed, non-tender mass in the left sacro-iliac region measuring 8 cm. in diameter. Pulsation in the mass was marked and was synchronous with the heart beat. A bruit was present. Eggshell crackling was easily demonstrated. Pyramidal tract signs were present bilaterally. Temperature, pulse, and respirations were normal.

Roentgenological examination of the pelvis revealed an irregular shadow of increased density extending medially and superiorly from the crest of the ilium to its posterior end. A biopsy showed histologically a typical benign giant-cell tumor. For therapy, 3,300 roentgen units were given through 4 portals over a period of eighteen days. There was no noticeable effect on either the size or the pulsation of the tumor.

At the first operation the tumor was partially excised; at the second, further tumor tissue was removed; and at the third operation another attempt was made at excision. On two occasions radium was inserted. By this means a total of 960 mgm. hr. were given. The tumor continued to pulsate.

At the fourth operation the left internal iliac artery was ligated, which resulted in the immediate cessation of the pulsation.

At the fifth and sixth operations the excision of the remainder of the tumor was accomplished. The total weight of the excised tumor was 400 gm. The operations were performed over a period of six months.

After operation the patient made an uneventful recovery and walked without difficulty. She left the hospital two hundred and thirty-seven days after admission. The cavity measured 8 by 8 by 6 cm.

In September, 1937, the patient again noted some difficulty in walking. On November 6, 1937, being unable to walk and presenting urinary incontinence, she was hospitalized. Bilateral spasticity of the lower extremities was present. Sensation was found to be intact. The patient appeared to be mentally deranged.

Biopsy taken from the granulating tissue showed no histological evidence of neoplasia. Both upper extremities became spastic. Left lower facial palsy developed. The patient died two weeks later from a clinical intracranial lesion. Autopsy was refused.

RICHARD J. BENNETT, JR., M.D.

Howard, N. J.: A New Concept of Tenosynovitis and the Pathology of Physiological Effort. *Am. J. Surg.*, 1938, 42: 723.

Crepitating peritendinitis is an acute pathological lesion resulting from the prolonged exertion of unaccustomed muscular effort. The lesion is recognized by the appearance of pain or crepitation on motion of a particular part of an extremity.

The principal factors in its occurrence are: trauma from direct violence plus the time interval of the trauma; increased use of the part plus the time element of the increased activity, especially upon return to a task after a prolonged lay off; the fatigue syndrome—weakness or cramps from prolonged use.

The pathological changes consist of edema of the peritendinous areolar tissue and muscle, particularly the muscle-tendon junction. Thrombosis of the venules occurs in these tissues. Deposits of fibrin in the areolar tissue and between muscle fibers are found to be the cause of the audible and palpable crepitation. The muscle fibers may undergo degenerative changes to the point of liquefactive necrosis within the sarcolemmic sheath. The areolar tissue and muscle both are found to have a more acid reaction, when colorimetric hydrogen-ion concentration studies are carried out. The individual muscle fibers lose their glycogen, and such tissue extracts are found positive for lactic acid. Both grossly and microscopically, the tendons are found unchanged. No tendon sheaths exist at the site of pain and swelling, and they cannot be involved in the pathological changes. The "crepitating tendo vaginitis" is a peritendinitis and myositis, the product of excessive fatigue of a definite muscle group, and not of rheumatoid, infectious, or toxic origin.

In a study of 72 cases of crepitating peritendinitis, it was found that 91.5 per cent occurred in males and 8.5 per cent in females. Thirty-eight cases followed direct trauma and accustomed or usual work and activity. The interval between the direct trauma and the development of crepitating peritendinitis averaged three days. Thirty-four patients gave no history and showed no evidence of direct trauma or sprain, and all had either returned to work or sport hobbies after long inactivity or had unusual tasks or unaccustomed exertion assigned to them.

In physiological experiments, fatigue of a muscle group is shown by a more or less complete loss of irritability and contractility brought on by functional activity. When complete fatigue occurs, a very long interval is necessary for recovery; after this further efforts to contract the muscle greatly prolong the period of recovery. It is observed that most patients with crepitating peritendinitis complain of "loss of power" entirely apart from pain.

Treatment logically should be directed toward complete and absolute rest of the involved muscle group. Immobilization is accomplished by means of moulded plaster-of-Paris splints lightly reinforced by circular plaster. Immobilization of the wrist without inclusion of the thumb is inadequate even though the other fingers are left free.

Thirty-four cases treated by complete plaster immobilization had an average disability period of eleven and six-tenths days. Twenty-five cases treated by straight board splints, with the thumb left free occasionally, had an average disability period of twenty-two and six-tenths days. If one chose from both groups cases in which immobilization was considered inadequate and was followed by physical therapy, the average disability period was forty-five and one-tenth days. Baking, massage, and diathermy have no place in the treatment of this lesion.

The time factor is important in the development of chronic lesions. The trauma consists of both the internal stresses from muscular exertion and the minor continuous external trauma associated with physical activity.

Subdeltoid bursitis is such a lesion. A. W. Meyer has repeatedly shown that attrition changes due to wear and tear are frequently present in the shoulder. This is true especially of the tendons that form the floor of the subdeltoid bursa. Barr, in a review of pathological calcification, defines dystrophic calcification as the deposits of lime salts in dead or dying tissue. Dystrophic calcification is dependent on local conditions only. According to Sanstrom and Wahlgren the dystrophic calcification of subdeltoid bursitis actually lies in the tendon and peritendon of the muscles attached to the greater tuberosity of the humerus, and the author calls this "peritendinitis calcarea." This is considered by Meyer to be dystrophic calcification in areas devitalized by attrition changes.

In the acute stage of this lesion, the author prefers to inject the bursa with from 15 to 20 c.c. of 1 per cent novocain and then gently manipulate the shoulder. In 18 cases so treated the average disability was four and seven-tenths days. Comfort was maintained by the use of an arm sling and diathermy. In chronic cases this method was not very effective.

Occupational cramps found in writers, milkers, seamstresses, and the like were considered dependent mainly upon the exhaustion phenomena in the interosseous and lumbricalis muscles, and occasionally in the muscles of the thenar and hypothenar eminences. F. HAROLD DOWNING, M.D.

Vernetti, L.: Plastic Operations on Tendons with Tubular Skin Flaps. Experimental Research (Plastiche tendinee con lembi cutanei tubulari. Ricerche sperimentali). *Clin. chir.*, 1938, 14: 931.

For his experiments on rabbits, Vernetti used the long extensor tendon of the toes and the Achilles tendon. After careful shaving and disinfection of the leg, two parallel incisions, about 2.5 cm. apart and perpendicular to the axis of the extremity, were made through the skin, and the edges of the incisions were approximated with separate silk sutures over a thin iron wire so as to obtain a tubular skin flap with the epidermis inside the lumen of the tube. The tube was then separated from the skin by two longitudinal incisions close to the line of suture, but was left attached to the subcutaneous tissue. With considera-

tion for the possible degree of retraction of the cutaneous tube, a proportionate part of the selected tendon was rejected, an individual catgut suture was passed through each end of the tendon and tied circularly round it, and the tube was swung into the defect and its ends were sutured to the corresponding ends of the tendon by means of three catgut sutures passed through the tendon above its circular ligature. The fascia was reconstructed whenever possible and the line of skin suture was arranged so as not to be superimposed over the operated zone. This is easily obtainable by the construction of the tube at a slight distance from the tendon to be operated upon. The diameter of the tube must correspond to that of the tendon. Results of the intervention were verified fourteen, nineteen, thirty, forty-five, and ninety days after the operation.

Macroscopically, the tube was found to be recognizable from the surrounding tissues as a whitish cord of smooth and shining contour and of a consistency varying in hardness and fibrosity according to the time elapsed since the intervention: in old cases the consistency was about the same as that of the tendon. The tube was found detached from the tendon at one end in only two animals, probably because of the thinness of the selected tendon. No adhesions to the tube were observed in any of the animals and all tubes were mobile: it seems that the loose subcutaneous tissue favors the sliding of the tube and prevents the formation of adhesions, especially when the animals are allowed to move about from the beginning. However, adhesions develop when the cutaneous suture line is superimposed on that of the tendon. The movements of the animals become normal from twenty to thirty days after the intervention.

Histologically, the dermal tube retains its vitality owing to its loose connections with the subcutaneous tissues which continue to nourish it. The epidermic layer does not cause any disturbances, becomes atrophied, and finally disappears. The connective tissue of the derma becomes denser and its fibers assume a longitudinal direction: after forty-five days the elements of the derma are unrecognizable and the lumen of the tube has disappeared. The attachment of the tube to the tendon is ensured by newly formed connective tissue which surrounds the extremities of the two elements and becomes fibrous with a longitudinal arrangement of its individual fibers, some of which penetrate between the elements of the tendon. No proliferation of the tendinous tissue has been observed. RICHARD KEMEL, M.D.

Mallet-Guy, P., and Frieh, P.: Para-articular Calcifications of the Shoulder, Tendinous Ruptures, and Periscapular Bursitis (Calcifications para-articulaires de l'épaule, ruptures tendineuses et bursites périscapulaires). *Rev. d'orthop.*, 1939, 26: 20.

A summary of the literature on lesions of the shoulder joints for the past thirty years is presented. The majority of the original papers were presented by Codman, Painter, Bergmann, and Stieda.

The pathology of the lesions as well as the pathological physiology of the calcifications are considered. The evolution of the calcareous deposits and the different locations in which they may occur are discussed. Roentgenologically the two shoulders with calcareous deposits may seem identical but pain may occur in only one. The poorness of the circulation at the site of these calcareous deposits at the musculotendinous junction may be responsible for the poor or absence of healing after spontaneous rupture or operative removal of the contents of these inflamed calcareous bursæ.

From the clinical standpoint, partial tendinous rupture and subsequent formation of a calcareous deposit are considered.

The first recommendation of treatment is that of immobilization in bed with the arm in abduction. Other methods of treatment are diathermy, infrared rays, and small doses of radiotherapy. It has been necessary to operate in many instances and the authors are of the opinion that the method of choice is local infiltration of novocain directly into the bursal sac and painful regions.

In the case reported by the authors pain had been present at the base of the right shoulder for six months, increasing little by little in intensity until it became intolerable. A roentgenogram confirmed subacromial calcification. Radiotherapy was tried without success. Two local infiltrations of novocain were attempted with complete success. The roentgenograms taken several days after the infiltration showed the disappearance of the calcification.

Puncture alone or puncture with aspiration of these sacs has been known to give good results in some instances. It is not possible to cure all cases by this method. If this method fails, the surgical method should be undertaken as a last resort. The operation is carried out under local anesthesia through a short, vertical, non-mutilating incision. The functional results are best and complete at the end of from three to six weeks.

RICHARD J. BENNETT, JR., M.D.

Casuccio, C.: Topography of the Sacro-Iliac Joint and Its Clinical Importance (Topografia della sacro-iliaca e sua importanza clinica). *Chir. d. organi di movimento*, 1938, 24: 83.

The ventral or anterior part of the sacro-iliac joint may be divided into two portions: a superior part lying in the greater pelvis, and an inferior part lying in the lesser pelvis. The two parts meet at almost a right angle, and in the adult are from 9 to 10 cm. long (Fig. 1). The superior part of the joint is covered by the belly of the psoas muscle, which crosses it obliquely from above downward, and from inward outward. Some fibers of the iliac muscle separate it from part of the joint. Through its fibers runs the crural nerve, which is separated from the joint by a thin muscular sheet composed of fibers of the psoas and iliac muscles. The obturator nerve runs parallel to the internal margin of the psoas. It is formed from roots which originate from the second, third,

Fig. 1. Right adult hemipelvis. The broken line indicates the ventral margin of the sacro-iliac joint; (2) iliopsoas; (3) crural nerve; (4) obturator nerve; (5) fourth lumbar root; (6) fifth lumbar root; (7) gluteal artery; (8) first sacral root; (9) piriformis muscle; (10) second sacral root; (11) third sacral root; (12) fourth sacral root.

Fig. 2. Drawing to show the topographical relations of the ventral margin of the sacro-iliac joint.

and fourth lumbar segments. Usually, about 7 cm. from its point of origin, the obturator nerve lies directly on the sacro-iliac joint (Fig. 2). A centimeter and a half caudad to the obturator nerve, a thick, flat ribbon (lumbosacral trunk) formed by the union of the roots of the fourth and fifth lumbar segments obliquely crosses the sacro-iliac joint a little below the union of its upper and lower parts. The lumbosacral trunk is from 8 to 10 mm. wide at this point and lies directly on the joint. More caudad between the fifth lumbar and first sacral roots are found the gluteal vessels which ordinarily make direct contact with the joint. The situation of these vessels, however, varies greatly. The relations between the first sacral root and the joint vary in different individuals. The root usually lies directly on the joint; sometimes the gluteal vessels separate it from the joint, and at other times the superior part of the piriformis muscle lies between it and the joint. The piriformis muscle covers the distal end of the lower section of the sacro-iliac joint for about 3 cm. This muscle always separates the second sacral root from the inferior extremity of the joint.

Diseases of the sacro-iliac joint are as numerous as diseases of other joints. Among these may be mentioned: tuberculosis, rheumatic and deforming arthritis, acute streptococci and staphylococci infections, neoplasms, arthritis of malta fever, and osseous lymphogranulomatosis. Clinical diagnosis is difficult on account of the proximity of this joint to the lumbar vertebræ and hip joint. Arthritis of the sacro-iliac joint may cause severe and widespread symptoms or be asymptomatic. Roentgen-ray evidence of a sacro-iliac arthritis in a patient suffering from various related symptoms does not necessarily mean that this joint is the cause of the symptoms; the symptoms may have origin in the lumbar vertebræ or in the hip joint. The most common symptom of sacro-iliac arthritis is pain, which varies greatly in intensity and distribution. Affection of the upper or cephalad part of the joint may involve the crural and obturator nerves and cause pain on the anterior and internal surfaces of the thigh; while involvement of the lower part of the joint may cause sciatic pain. Limitation of movement of the hip is probably caused by contiguity of the inflammation from the joint to its adjacent muscles, the ilio-psoas and piriformis anteriorly, and the gluteal posteriorly. Inflammatory changes in these muscles involve the movements of abduction

and flexion-abduction mostly and are the cause of the pain felt at times in forced flexion (Gaeslen sign), forced flexion-abduction of the hip (Laguère sign), or hyperextension of the hip, or the cause of limp. In 84 per cent of 65 cases discussed by the author and checked roentgenographically limp was present and in 46 per cent sciatic pain.

DAVID IMPASTATO, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Samson, J. E.: Fixation of the Femoral Aponeurosis for Paralytic Hip (Aponévropexie fémorale dans la hanche paralytique). *Lyon chir.*, 1938, 35: 641.

Samson advocates a method of treatment for paralytic hips which he describes as fixation of the femoral aponeurosis. A section of this fibrous, strong, resistant aponeurosis is passed through tunnels in the trochanter and ilium, turned on itself around the crest of the ilium, and reinserted in the great trochanter where it is fixed with kangaroo tendon. With the proper adjustment of this aponeurosis and determination of the tensor action necessary, the extremity may be brought into good position.

For this operation the entire length of the aponeurosis should be used, and Maissiat's band should be included. The tunnels in which the aponeurosis is to be placed should be of sufficient width to allow free play; in the great trochanter the tunnel is always made at the base of the bone. With complete paralysis of the gluteal muscles the tunnel in the ilium is made as close as possible to the posterior superior iliac spine, as this best corrects the anteflexion; if the paralysis is only partial, involving only the gluteus medius, the tunnel is made nearly in the center of the wing of the ilium. With the extremity in good position, it is placed in a plaster cast for from five to six weeks. After removal of the cast, the patient must be trained to use the limb, and finally to walk without support.

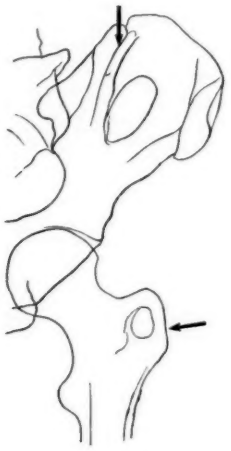

Fig. 1. Schema showing the size and position of the tunnels in the trochanter and ilium.

The author has performed this operation 131 times on 105 patients; of these 72 have been reexamined or have been traced by correspondence. All of the 23 patients operated upon for partial paralysis (gluteus medius) show complete or nearly complete correction of their deformities. Thirty patients operated upon for total paralysis of the gluteal muscles are able to walk without support and with mobile knees, and 10 of them have required an arthrodesis of the knee joint to correct a shortening of the limb of several centimeters. In 7 cases with a tensor paralysis, the hip is nevertheless stable. In 8 cases the operation was unsuccessful, either because of the fact that the tunnels were placed too far forward, or because the aponeurosis broke away from the point of insertion in the trochanter. Two patients have died from intercurrent disease; 5 have been operated upon too recently to determine the final results. Five illustrative cases are reported; 3 patients were operated upon before the age of ten years; the 2 others (girls) were operated upon at the age of sixteen.

ALICE M. MEYERS.

Bonola, A.: The Surgical Mobilization of Post-traumatic Rigidity of the Knee (La mobilizzazione cruenta delle rigidità post-traumatiche del ginocchio). *Chir. d. organi di movimento*, 1938, 24: 59.

Bonola has treated surgically 26 cases of post-traumatic rigidity of the knee: 8 were due to serious fracture of the patella, 8 to complicated condylar fracture, and 10 to fracture of the femoral diaphysis, especially the lower third. All cases had been immobilized for more than five or six months. The age of the patients ranged from seventeen to forty years, and 24 of the patients were males. In all cases, mobilization of the knee was a vital factor for the work or the career of the patient, and the will to be cured was of decisive importance for the success of the operation. Ample destruction of cartilage was found in 9 cases operated upon from nine months to three years after the traumatism had occurred. Contraindications consist of grave lesions or insufficiency of the extensor muscles, peripheral nerve lesions, and a poor condition of the skin. The rigidity of the knee may be due to changes in the extensor capsular apparatus and in the skin, to adhesions in the joint, and to changes in the articular cartilages caused directly by the edges of the articular fractures or through detachment of fragments of cartilage, or indirectly through atrophy from inactivity (Fig. 1).

In many patients pre-operative physical therapy was instituted for several weeks because success depends on the condition of the skin, the absence of even slight inflammatory reactions in the joint, the

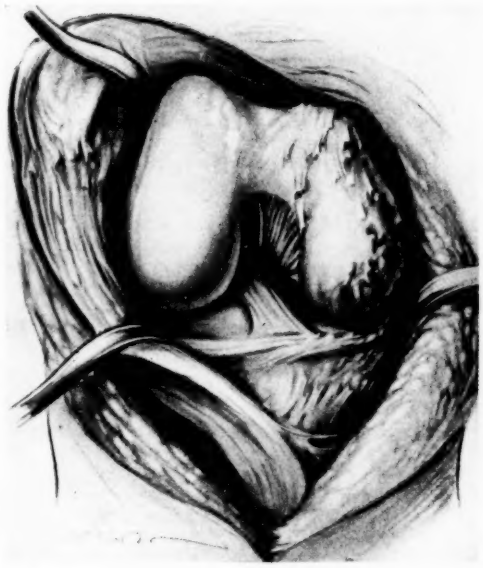

Fig. 1.

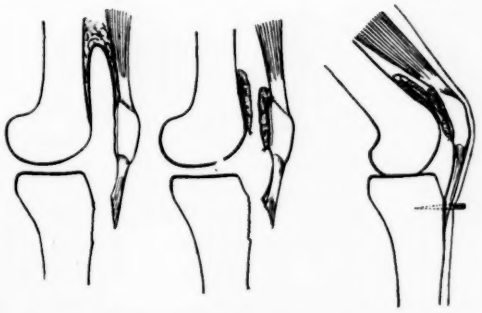

Fig. 3. After articular extension beyond 90 degrees is obtained, when the cartilaginous surfaces are altered, a pedunculated flap is made by sliding the anterior wall of the subquadricipital cul-de-sac, rich in adipose tissue, onto the posterior aspect of the patella, while the posterior wall of the cul-de-sac is made to cover the femoral condyles. Fixation of the tibial protuberance is done by transcutaneous introduction of Putti's nail with the knee flexed at about 40 degrees.

nutrition of the extensor apparatus, and the maintenance of the axis in the femoral and tibial segments. Before operation was performed, a lapse of two or three months was allowed after complete healing of traumatic wounds, and a lapse of ten or twelve months after healing of suppurating lesions. Ether anesthesia was used. The latero-external parapatellar incision of Kocher, extended 3 or 4 cm. further above and below to permit ample inspection of the joint and detachment of the tibial protuberance, was employed in most cases. This was followed by section of adhesions in the subcutaneous tissue and the extensor apparatus, freeing of the tibial and femoral condyles from the retracted and sclerosed capsule, removal of the thick cicatricial articular shell, with care whenever possible not to disturb the crucial ligaments and the continuity of the extensor apparatus. In 10 cases it was necessary to lengthen the quadriceps tendon to obtain flexion beyond 80 degrees, but in 6 cases preference was given to detachment of the tibial protuberance. Usually, section of the adhesions of the extensor apparatus allows flexion not exceeding 50 degrees, while section of the intercondyloid adhesions allows flexion reaching 80 or 90 degrees (Fig. 2). When flexion beyond 90 degrees has been obtained, the altered articular cartilages are covered with flaps of fascia lata, of aponeurosis from the lateral vastus, or of the subquadricipital synovial cul-de-sac, the anterior part of which is made to cover the posterior aspect of the patella, and the posterior part the femoral condyles

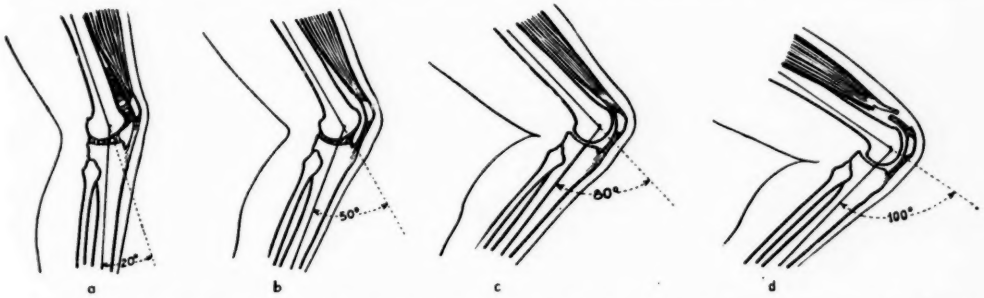

Fig. 2. Schema of the stages of surgical mobilization of the knee. a. Articulation before operation. Flexion is possible to 20 degrees only. b. After removal of the adhesions of the extensor apparatus (quadriceps, patella) flexion up to 50 degrees is obtained. c. In order to flex the knee beyond 50 degrees it is necessary to cut the intercondyloid adhesions. d. Further flexion beyond 90 degrees is possible only by lengthening of the extensor apparatus

(Fig. 3). With the knee in semiflexion, the detached tibial protuberance is fixed above its former position by means of a double-headed Putti nail traversing the skin. The joint is immobilized for ten days; the sutures are removed after from fifteen to twenty days, and Putti's nail after from twenty to thirty days. Postoperative physical therapy is of extreme importance and very protracted. Weight-bearing and walking are allowed after twenty or thirty days and the plaster bandage is removed after fifty or sixty days. Usually, the after-treatment lasts three or four months, and six months are needed to obtain complete extension. No serious postoperative complications occurred, but in 4 cases it was necessary to tap articular hematomas.

Of the 26 cases which were treated surgically, 22 could be followed up for from one to twenty years. In all cases in which adequate postoperative treatment was given, active extension was practically normal and the joint was stable and painless. The results were excellent in 7, good in 10, mediocre in 3, and poor in 2. RICHARD KEMEL, M.D.

FRACTURES AND DISLOCATIONS

Campbell, W. C.: Onlay Bone Graft for Ununited Fractures. *Arch. Surg.*, 1939, 38: 313.

Campbell states that two factors are necessary for a high percentage of excellent results in cases of non-union; namely, (1) absolute fixation, and (2) promotion of osteogenesis (callus formation). If there is no progress toward union at the end of six months, the diagnosis of non-union may be made.

In 213 patients the massive onlay bone graft was used on 261 bones with non-union. The steps in the operation are as follows:

An ample incision is made over the site of non-union. All intervening scar tissue is excised. An incision is made through the periosteum of each fragment and the periosteum is stripped from 1 to ¾ in. from the circumference, care being taken that the soft parts which have been attached to the periosteum are not removed. The adjacent ends of the bone are freshened and each medulla is reamed out until normal marrow tissue is removed. Shavings are removed from one portion of the circumference until there is a continuous flat surface of 10 cm. on each fragment, if possible. A broad flat massive graft is taken from the tibia. The graft is split longitudinally by means of a motor saw through the edge or small diameter into two parts, a strong outer plate consisting of dense bone or cortex, and an inner layer, the endosteum. A strip of endosteum is placed within the medulla. Six or eight autogenous bone nails of appropriate size are made from the outer plate. Three or four drill holes are then made through the graft and through the fragment into which the autogenous bone nails are driven. The remainder of the endosteum is broken into small particles and placed with the shavings about the site of the fracture. Spongy bone from the upper part of the tibia is obtained with a sharp bone curette and applied around the area of fracture. Complete fixation is then obtained by means of a plaster-of-Paris cast or an efficient splint for a period of eight weeks. Following this a "convalescent" splint is applied in the form of a leather corset to reproduce the cast. The period of fixation is usually from two to four months. Active motion may be instituted at the end of from two to three months. The graft should not be applied under tension or gradual dissolution at the point of tension will result.

The author is of the opinion that of the 31 cases of infection in this series, 29 could be attributed to the relighting of a previous pyogenic infection which occurred in compound fractures. It was necessary to regraft a bone in 5 instances in this series. There was solid union in 93.6 per cent of 251 operations. Sequestration occurred in 24 of the 31 cases of postoperative infection. In 7 of these union failed after sequestration. Grafts were 100 per cent successful in 15 patients more than fifty years old.

There were 16 cases in this series in which the onlay method failed to produce a union. The end-result of this type of onlay graft showed that the bone nails gradually disappeared and that there was usually permanent evidence of the graft as shown by an increase in the diameter of the shaft.

RICHARD J. BENNETT, JR., M.D.

Heyl, J. H.: Fractures of the Upper Extremity and the Shaft of the Humerus. *Arch. Surg.*, 1939, 38: 295.

One hundred and six cases of fracture of the upper extremity and shaft of the humerus occurring in a five-year period are analyzed to evaluate traction in abduction as a form of treatment.

Nine cases of fracture of the shaft required open reduction because of malposition. Eight of these were of the transverse type, traction being least effective.

Patients were hospitalized until clinical union was obtained, callus being noted at four weeks and clinical union in five or six. Limitation of motion at the scapulohumeral joint was not a notable feature, excluding fractures of the head and surgical neck. Skeletal traction was required in only 2 cases.

Of 17 cases of fracture of the greater tuberosity, 12 were associated with dislocation at the shoulder joint and were satisfactorily reduced upon reduction of the dislocation. The results in this group seem to favor abduction treatment, the average hospitalization being seventeen days.

Only 1 case of epiphyseal separation of the upper end of the humerus occurred in this series. There were 46 fractures of the surgical neck in 14 of which the greater tuberosity or head was involved, and in only 1 was there associated dislocation. No typical displacement was noted; the weight of the upper extremity and the fracturing force were seemingly the determining factors.

Firm impaction was exceptional. Cutaneous traction alone was not effective in reducing the overriding in fractures of the surgical neck. Traction abduction

was noted to increase the deformity in some cases. It seems preferable, according to the author, to align the distal fragment with the proximal one. This eliminates 90-degree abduction in most cases. However, he notes that partial loss of abduction and external rotation is not apt to occur as frequently when the part is treated in abduction.

In the treatment of fractures of the shaft, traction abduction in combination with closed reduction proved an effective method of immobilization. This was true especially in fractures of the middle third and, to a lesser extent, in those of the upper and lower thirds. No cases of non-union of the shaft occurred in this series. LOUIS SCHEMAN, M.D.

Magnuson, P. B., and Stinchfield, F.: Fracture of the Os Calcis. *Am. J. Surg.*, 1938, 42: 685.

Fracture of the os calcis, with few exceptions, is caused by a fall from a height when the body weight strikes on the heels. The impact of the weight of the body against the heel drives the posterior two-thirds of the os calcis upward and outward and compresses it. The heel is shortened from front to back and broadened. The violence that causes the fracture and impacts the fragments actually disintegrates the bone cells, causing permanent loss of total length, so that no amount of manipulation will completely restore the bone to its normal shape. The foot becomes pronated, the longitudinal arch is lowered, the peroneal tendons are displaced outward and may become compressed between the lateral surface of the os calcis and the fibula. There is immediate, extensive, hemorrhagic swelling followed frequently by bleb formation.

The lines of fracture are irregular and are not in planes, which is easily shown by anteroposterior and lateral roentgenograms. Roentgenograms should always include stereolateral, lateral oblique, and anteroposterior views. An anteroposterior roentgenogram showing the posterior two-thirds or three-fourths of the os calcis and the malleoli can be obtained by placing the plate against the sole of the foot with the patient in a prone position, with the tube set close to the back of the knee and the rays projected downward and parallel with the long axis of the tibia. This view will give information regarding the widening and the amount of displacement of the posterior two-thirds of the os calcis. The lateral-oblique view is taken to show the anterior superior tip of the os calcis which may be fractured. This frequently small, triangular-shaped fracture fragment is likely to produce subsequent pain. The stereolateral view will show the lines of fracture into the astragalocalcaneal joint and the amount of change in the salient or tuberosity joint angle. In fractures of the os calcis this angle is lessened, disappears, or is reversed.

Numerous difficulties are encountered in the reduction of a fractured os calcis because this fracture is always impacted and the impaction is so firm that great force properly applied is necessary to overcome it. Without disimpaction nothing can be gained by any treatment. Tongs, mallets, wires, and plaster casings are useless unless they improve the position of the fragments and maintain them in the improved position. Methods mean nothing unless they are applied intelligently and are adapted to each case. The fact that several methods have been devised implies that none are easy to apply with the assurance of a satisfactory result.

There are certain fundamental principles to be considered in the treatment of a fractured os calcis. The technique necessary to care for a particular fracture will have to be devised. It may be that none of the widely publicized methods will meet the requirements and a combination of several or selected parts of several will be necessary. Four fundamental objects in treating a fractured os calcis are: (1) to break up the impaction, (2) to remold the fragments downward and inward, away from the external malleolus, and restore them to their normal position in relation to the mid-weight bearing line of the foot; (3) to increase the height of the arch and re-establish the mechanics of the foot, enabling it to bear weight again without pinching the peroneal tendons, and to avoid throwing undue strain on any of the mechanical structures that support the weight of the body as it applies to the foot; and (4) to restore the plantar fasciæ to normal length.

It is almost certain that a fracture of the os calcis involves the astragalocalcaneal joint, and a rough weight-bearing joint surface, further complicated with adhesions, will probably produce pain regardless of the position of the os calcis. Weight-bearing on a joint that is rough and irregular will produce traumatic arthritis. There is always some thickening and induration of the internal and external lateral ligamentous supports which result in fibrosis of these structures and limitation of medial and lateral motions.

The results of treatment of this injury have improved, but the results will never be perfect in the hands of anyone, or as a result of using any one method. It is an intra-articular fracture in which a certain amount of bone has been destroyed and it is subjected to the trauma of weight bearing. To restore painless function implies perfect mechanical restoration of bone, which frequently is impossible; it also implies a freedom of motion between the os calcis and the astragalus which is practically always limited, regardless of the methods used in reduction and maintenance of reduction. It is almost impossible to obtain ideal results.

The authors believe that the first step in treatment is to prevent swelling and rapid bleb formation which generally occurs as an immediate result of this fracture. The most satisfactory method used by the authors is the pillow splint advocated by Gurd. When properly applied, this will absolutely prevent the occurrence of bleb formation and will reduce the swelling so that within the short space of forty-eight hours the treatment necessary for reduction of the fracture can be applied. Rather than to permit swelling to occur, the surgeon should postpone the

roentgenogram and put on a pillow splint or massive compression dressing promptly. The fragments do not change position; it is the swelling and bleb formation only that prevent reduction within a couple of days after occurrence of the fracture. Should there be bleb formation, which cannot be cleared up in less than ten days or two weeks, treatment must be postponed until fixation can be applied. Therefore, if swelling is permitted to occur, reduction of the fracture must be deferred until such time as the skin is in condition to tolerate the application of some fixation.

In 1917 Magnuson advocated cutting the Achilles tendon to relieve the action of the gastrocnemius and soleus muscles. This is very effective for maintenance of position of the fragments, but the calf muscles are permanently weakened and a disability results. Tenotomy of the Achilles tendon has been discontinued.

In regard to the employment of pins and calipers it must be remembered that a comminuted fracture, and nearly all fractures of the os calcis are comminuted, cannot be reduced, nor can all the fragments be maintained in reduction by placing traction on one fragment even though it is larger than the others.

In reviewing the various advocated methods of treatment, some from personal observation, the methods of the following authors appear to the authors as being the most logical procedures: Herman, Conn, Goff, Bohler, and Wilson. Pertinent points of each method are presented and discussed.

Herman's method was developed to eliminate the 10 per cent of cases that develop sepsis with the use of Kirschner wires and Steinman pins, and to prevent excessive bone formation beneath the malleoli. The after-care is emphasized as being the most important step in the entire treatment. The plaster casts and submalleolar pads are replaced every two weeks. A special ambulatory os-calcis brace is used following the removal of the last cast, and details regarding physical therapy, exercises, and shoe alterations are carried out. Herman believes the good results are due chiefly to the after-treatment which tends to maintain continued pressure beneath the malleoli and prevents the piling up of bone.

Conn reported a series of cases in which he used four different methods, but does not say upon what points of variation in the fractures he based his choice of method: (1) subastragalar arthrodesis, with or without regrooving for the peroneal tendons; (2) combined forcible lateral compression of the os calcis with skeletal traction; (3) a two-stage operation of lateral compression and skeletal traction for five weeks, followed by a combined subastragalar, astragaloscaphoid, and calcaneocuboid fusion; and (4) on old cases in which a painful subastragalar motion was present, a triple arthrodesis. He believes that the results obtained were by far the best when the third method was used. In the opinion of the authors this would not be justified in the average case.

Goff's method is designed to allow the patient to be ambulatory within forty-eight hours after reduction. A plaster cast is applied from the toes to the midthigh and with the knee flexed 20 degrees a Bohler walking iron is incorporated. At the end of the second week the cast is cut below the knee, the lower half of the cast is removed in ten weeks, and full weight-bearing is permitted at the end of eleven weeks. The authors question the advisability of allowing weight-bearing so soon after the fracture because there must be some body-weight pressure on the inferior surface of the os calcis which would have a tendency to force it up into a mal-position.

In Boehler's method the injured leg is elevated on a Braun frame without traction and light massage is administered for eight or nine days before reduction and skeletal traction are employed. Boehler has discontinued the use of the Kirschner wire through the tibia for countertraction because of the danger of infection in the tibial region and about the ankle joint, which he states he has observed rather frequently. He depends on countertraction from the flexed knee on the Boehler frame at the time of the initial reduction.

When reduction is obtained, a non-padded skin-tight plaster is applied, carefully molded about the foot and ankle. The leg is again put on a Braun frame, and traction of 15 lb. is applied on the Kirschner wire. This remains constant for six weeks, at which time the wire is removed and a new plaster is applied, into which is incorporated a walking iron. This is removed six weeks later. At the end of from fourteen to sixteen weeks after the initial reduction, the plaster and walking iron are discarded and full weight-bearing is allowed. The patient is fitted with a shoe containing an inner sole to maintain the newly formed longitudinal arch. Boehler does not present such an ideal picture of the results of his method as seems to be prevalent in this country. He states that traumatic arthritis is frequent and cautions against overuse of the redresseur because of the possibility of a slough, and against too early weight-bearing.

Wilson concluded that it was almost impossible to get anatomical reduction in fracture of the os calcis, and advised immediate subastragalar arthrodesis. He followed this method for some time. He exhibited very satisfactory results so far as painlessness was concerned, but the deformity produced by impaction and displacement of the fragments was not changed, except insofar as the os calcis was moved somewhat inward at the time of operation, and the heel inverted somewhat more than is usually the case immediately following fracture. Wilson's results were due probably to the fact that at the time of operation he was able to restore, more or less, the weight-bearing position of the os calcis, that is, two-thirds lateral to the mid-weight-bearing line and one-third medial thereto; also the whole bone was moved medially at the time of operation.

This is a valuable operation and is necessary in probably from 30 to 35 per cent of cases even after

proper reduction, but in the author's opinion it should be postponed until the fracture is reduced and healed in as near anatomical position as it is possible to attain. Then, if the patient has a painful astragalocalcaneal joint, Wilson's procedure should be followed. In these cases, the operation if properly performed gives a highly satisfactory result after ankylosis of the joint.

In 1923 Magnuson advocated an operation for the relief of disability in old fractures of the os calcis. In this operation the mass of callus which lies behind and beneath the external malleolus, which is an outgrowth of the widening and fracture of the os calcis, was removed with a gouge, and the groove left much deeper than normal.

After the mass of bone had been removed from behind and beneath the external malleolus and the lateral supports of the ankle severed in getting to this excess callus, a Thomas wrench was applied with the proximal arm lying along the outer margin of the foot over the os calcis and extending forward over the fifth metatarsal, the distal arm lying against the medial side of the astragalus just below the internal malleolus. With strong, smooth, steady pressure the foot was inverted, and with it the os calcis was carried medially.

It was found that a skin-tight plaster, applied to the lower leg and heel and held firmly until it set, was the easiest method of maintaining the heel in its position. The anterior part of the cast is applied after the height of the longitudinal arch is increased by firm eversion of that part of the foot anterior to the astragalus and after the posterior half of the cast has hardened. In this way the height of the arch was increased, the os calcis was moved over to the midline, and the pinching of the peroneal tendons was ultimately relieved.

ROBERT P. MONTGOMERY, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Watson, W. L., and Silverstone, S. M.: Ligature of the Common Carotid Artery in Cancer of the Head and Neck. *Ann. Surg.*, 1939, 109: 1.

The authors present an analysis of 20 cases in which the common carotid artery was ligated at Memorial Hospital, New York City, during the years from 1926 to 1937. There were 17 men and 3 women, and their average age was fifty years. The youngest patient was a man, aged twenty-seven years, and the oldest a woman, aged sixty-nine. The left carotid artery was ligated in 13 cases and the right in 7. In 10 instances a modified Crile clamp was applied for periods varying from twenty minutes to forty-eight hours. Seven of the patients died between six and one hundred and twenty hours after the operation.

Further analysis reveals that 11 patients died within five days of the operation. In 7 of these, the Crile clamp had been used and in 4 an immediate ligation had been performed. In 6 of these 11 cases, death was preceded by the development of hemiplegia, and in 5 of these the Crile clamp had been used.

There were 6 patients in whom it was necessary to remove the common carotid artery at operation. Four of these made an uneventful recovery. The authors conclude that from this it would seem that immediate excision of the common carotid artery is less dangerous than simple ligation of the same vessel. Excision probably removes to a certain extent the dangers of thrombosis and embolism. The authors note that the most frequent cause of death following ligation of the common carotid artery is one form or another of cerebral complication; 8 patients in this series developed convulsions. Of those who died, 70 per cent showed definite signs of cerebral involvement.

The history of the operation of ligation of the common carotid artery is interestingly but briefly presented. The details of the technique of the operation used by these writers are described. In a summary, the authors conclude that the facts assembled by them seem to indicate that in patients with cancer, ligation of the common carotid artery as an emergency procedure is hazardous. The operative mortality in their series was 55 per cent. Because of frequent variations and abnormalities in the anatomy of the arteries of the neck and brain, it is suggested that these anatomical anomalies may largely explain the variety of cerebral complications occurring after ligation of the common carotid artery.

The collateral circulation outside of the cranium is probably of little significance after ligation of the common carotid artery. Age is apparently not a significant factor in the prognosis. The 5 youngest patients in this series died postoperatively. Six of the 9 patients who recovered were over fifty years of age.

The use of the Crile clamp for gradual occlusion of the common carotid artery does not improve the prognosis. The most frequent cause of death was a brain complication; while embolus, hemorrhage, and edema of the glottis are frequent factors in fatal termination. Thrombosis probably occurs quite frequently after ligation.

Finally, the authors note that uncontrolled cancer, sepsis, debilitation, hemorrhage, dehydration, and low blood pressure are factors influencing a fatal outcome following ligation of the common carotid artery. The pre-existing congenital blood vascular supply to the brain is an important factor, which determines whether life can be maintained after one common carotid artery has been ligated.

HERBERT F. THURSTON, M.D.

Kappis: The Present Status of Surgery of the Blood Vessels (Derzeitiger Stand der Gefaesschirurgie). *Zentralbl. f. Chir.*, 1938, p. 2290.

The tradition that Antyllus undertook the first splitting and extirpation of an aneurysmal sac after ligation of the afferent blood vessels in the second century A.D. is legendary. However, it is certain that up to the turn of the century, surgery met only the purely mechanical demands of hemostasis. As compared with simple ligation the arterial suture introduced shortly after the turn of the century was a distinct advance. In 1907, Lexer found the ideal operation for aneurysm to be excochleation of the aneurysmal sac and transverse suture of the afferent and efferent vessels. If necessary, a piece of the saphenous vein could be intercalated. The solution of functional problems through his periarterial sympathectomy stimulated Leriche in 1914; but the treatment of hemorrhage was left untouched and the greater problem was first considered during the World War. The results of the ligation are shown by the extensive statistics of Rabe (1885), Wolf (1907), and Heiderich (1921). They show that a necrosis of the extremity appears in a definite percentage of cases following a ligation of certain arteries. Since these, however, include recent and older injuries, secondary hemorrhages, and aneurysms, they do not show a clear picture of the question when no necrosis of a limb follows ligation of an artery. The greatest teacher in injuries of arteries was the World War, and Surgeon Major General Franz in his text book on war surgery in the chapter on the shot injuries of the blood vessels has collected a great number of cases of the World War both among Germans and the enemy and has evaluated them as far as this is possible. However, even these large statistical studies of Franz could not answer the question whether one should ligate or suture in the individual case. The individual surgeon will

always be compelled to decide this question for himself and bear the responsibility.

It is certain, however, that the number of necroses of the extremities, even according to the English Sanitary Report, which Franz has utilized, is very large following ligations, especially following ligations at the site of election. The mortality after ligations amounted to about 15 per cent and after sutures to 4 per cent; necroses of the extremities following ligation occurred in 10.5 per cent of the cases, and after suture in 3 per cent (Franz). Accordingly, the suture offers a more favorable outlook for the maintenance of limb and life. In addition, in his army corps Franz estimated only 325 (1 per cent) of such hemorrhages among 32,625 injured. For the very reason that a sufficient number of surgeons capable of doing vascular suture should be available in time of war, it seems important that this treatment be practiced in peace times. Drescher states (1936) that arterial suture was done only 3 times, according to the literature, in 64 injuries of arteries following dislocation of the shoulder: necrosis of the arm developed in 2 cases and death occurred in 1. The figures in knee and other injuries should be equally as bad. On the other hand, Kappis presumed that the good results are not reported. According to the English Sanitary Report, shot fractures of the thigh with arterial injury showed a mortality of 80 per cent. Primary amputation is the safest curative procedure. Kappis expressed the surmise that improvement in the treatment of fractures and arterial suture will save many a leg in the future. Primary arterial embolectomy was carried out successfully by Lahey in 1911 and at about the same time by Key of Stockholm. The latter has become the protagonist of this procedure. However, the results are not encouraging: of 382 patients operated upon in Sweden, 227 died in the hospital; in 69 (18 per cent) an amputation was necessary; in 86 (22 per cent) the result was good. Embolism of the bifurcation of the aorta caused the greatest mortality. According to Haimovici, 9 of 38 embolectomies on the aorta were successful.

The permanent results are poor also, as the patients are persons suffering from a cardiac or vascular disease. The statistics of Lund on 56 of his own observations show that of 29 patients who were treated conservatively for peripheral embolism 24 died: 5 left the hospital, 3 after and 2 without amputation of the extremity. Twenty-seven patients were operated upon, 24 by embolectomy: 10 survived, 5 had amputations, and 12 died. The mortality of operative treatment was therefore 44 per cent while that of conservative treatment was 82 per cent. Operations after nine hours, figured from the onset of the embolism, no longer brought success to Lund. Immediate treatment is, therefore, necessary.

Denk introduced the intravenous or intra-arterial injection of 0.06 gm. eupaverin in the treatment. This can be repeated after a short time. If after one hour at the latest no result is visible, an immediate embolectomy is indicated. With his procedure Denk has cured 19 of 33 peripheral embolisms, improved the condition in 5 cases, and had no success in 9 cases. To be sure, a vascular spasm may simulate an embolism. At any rate a trial of this procedure is justified. After a lapse of ten hours an arterial resection according to the Leriche technique may still bring results. A lumbar sympathectomy with removal of the second to the fourth or fifth lumbar vertebræ seems to give more hopeful results. This is also indicated in juvenile arterial disturbances.

In 1879 Winiwarter described the first case of endarteritis obliterans. He was followed by Buerger of New York, with a monograph on thrombo-angiitis obliterans. According to the author there is hardly a remedy that has not been tried in this disease. As a result valuable time is often lost for surgical measures. In 1924, the Argentinian Dièz showed the way with a successful lumbar sympathectomy in a young individual. In the meantime many permanent results have been achieved. A prerequisite, however, is that the circulation in the endangered extremity should not be completely interrupted. The operation must not become the last refuge: it must be undertaken early.

In 1916 Jonnescu removed the left stellate ganglion for the relief of angina pectoris. The results with it are not uniform. Some of the patients operated upon were left with the pain or suffered from other kinds of pain. According to Ochsner, Leriche had the following results in 163 patients whom he operated upon: 55.5 per cent were good, 20.2 per cent showed improvement, and there were 12.9 per cent of failures. The reproach, that with the removal of the pain one also eliminates the danger signal that warns the cardiac patient against overexertion, is unjustified according to many experiences. Leriche says that the loss of the stellate ganglion brings with it at the same time the loss of the noxious vasoconstrictor reflexes and, therefore, the spasms of the coronary arteries which are dangerous for the heart and the coronary arteries. The removal of the stellate ganglion and the dangerous reflex center can in this way and at the same time cure also the disease of the coronary arteries themselves, especially in the early cases. The removal of the stellate ganglion could in this way not only symptomatically eliminate the pain of the angina pectoris, but also act curatively upon the diseased cardiac vessels. Instead of the operation, paravertebral injections of alcohol were made into the upper thoracic ganglia by Mandl, Swetlow, Withe, and others. With this procedure, Withe had the following results in 38 cases: unquestionably good, 70.3 per cent; good, 16.2 per cent; improvement in the condition, 5.4 per cent; failures, 8.1 per cent; and 1 death.

In 1932, Blumgard proposed the total extirpation of the thyroid gland in cases of cardiac insufficiency not curable by internal measures. The frequently striking improvement in cases operated upon for Basedow's disease suggested it to him. Two of his own cases, in which even the ligation of the two

superior thyroid arteries led to the disappearance of cardiac murmurs and cardiac enlargement, made the author pay special attention to this idea, especially since the dangers of myxedema and of tetany are so slight. Inasmuch as even the subtotal removal of the gland should be sufficient, the author was more inclined to the latter. According to an American collection of statistics by Parsons and Parks "noteworthy" results were achieved in America with this operation in angina pectoris and cardiac insufficiency. For this reason, at the present time, when it is apparently possible to bring almost half of otherwise incurable patients operated upon in this way into a good or considerably improved condition, the question arises whether one should not gradually adopt this operation with caution.

The vascularization of the heart that has become anemic was proposed by Beck, an American, in 1935. In 1938, the Englishman O. Shaughnessy presented a film at the Surgical Congress. For the purpose of the vascularization in man the peritoneum, lung, and parts of the musculature of the thoracic wall are suitable. However, the introduction of an aleuronat paste into the pericardium for the purpose of securing adhesion of the visceral and the parietal layers seemed to the author to be the most preferable procedure.

The true cause of hypertension is as yet still unknown. At any rate, 15 patients with adenomas of the adrenal medulla were cured also of their hypertension by the removal of the tumor. Some time ago Bruening expressed the view that extensive removal of the vasoconstrictor nerves should lead to the reduction of the blood pressure. After many kinds of experiments, some at the Mayo Clinic, the best remedy for the reduction of the blood pressure seems to be: the division of the splanchnicus major and minor on both sides, the extirpation of the first and second lumbar ganglia on both sides, and the reduction in size of both adrenal glands, an intervention that should be done in two sittings. Allen and Adson have carried out 45 such operations without a fatality and with the result that in 70 per cent of the cases the symptoms referable to the eyes, kidneys, and heart disappeared. The blood pressure remained unchanged in 45 per cent of the cases, and was affected favorably in 30 per cent and excellently in 25 per cent. The author would also have liked to discuss lumbar sympathectomy and reproductive power, ambulatory thrombosis of the veins and compression bandages, puerperal sepsis, and ligation of the veins, but his own illness prevented him from doing so.

As a pathologist, Nordmann expressed his opinion on operations on the nervous system: functional disturbances present only apparent or secondary changes, but more difficult to understand is the rôle of the vascular nervous system in such completed anatomical findings as in endarteritis obliterans, as this involves the obliteration of large vascular stems. Since Buerger's monograph on thrombo-angiitis obliterans much has been included recently, which already had been excluded according to the clinical and anatomical findings and ought to be excluded again. In the case of endarteritis obliterans of Winiwarter there was a connective-tissue filling of the vascular lumina. Vascular spasms and dilatations precede the gangrene. Nordmann denies the existence of organized thrombi. The functional disturbances provide proof of an increased activity of the vascular nervous system. The afferent impulses probably come from the central nervous system. Symmetrically arranged vascular areas are affected. At first ischemia appears and then cyanosis. During the existence of the former, the entire vascular system is constricted or occluded; during the cyanosis, according to the experimentally found hyperemia of Ricker, the terminal vascular areas are dilated, but the afferent arteries are constricted. This spasm produces stasis of the lymphatic circulation in the vascular wall and this stasis again stimulates the endothelium to new growth. In this way there develops at first a pathological stimulation of the vascular nervous system and ultimately a connective-tissue occlusion of a vascular lumen. Inasmuch as the innervation of the vessels is segmentary, the Leriche operation can eliminate only a portion of the vascular nervous system. The higher the point of attack is chosen, the better will be the result. Inasmuch as the endocrine glands influence the activity of the vascular nervous system indirectly, their elimination (thyroid gland and adrenal gland) seems to be justified in certain cases.

(Plenz). Louis Neuwelt, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Bottin, J.: Two Tests of Dehydration in Surgical Conditions (Deux tests de déshydratation chez les malades chirurgicaux). *Presse méd.*, Par., 1938, 46: 1763.

Bottin has employed two tests to determine the state of hydration and dehydration of the tissues and blood in surgical conditions. His first test is similar to that of Aldrich and McClure except that the physiological saline solution (10 c.cm.) is injected into the subcutaneous instead of the intradermal tissues, and the time of its absorption determined. The author prefers the subcutaneous method, since when it is necessary to supply fluid after an operation, physiological saline is often given subcutaneously (by hypodermoclysis), and this test serves to determine the condition of and the absorption from the subcutaneous tissues

In patients who are in good condition and in whom the rate of absorption is normal with this test, the author has found that after operation there may be an acceleration of the absorption rate after an uncomplicated operation. This indicates that there is a slight dehydration of the blood, which is corrected by the blood's taking up fluid from the tissues, so that there is a slight and temporary dehydration of the tissues. In these uncomplicated conditions, the absorption rate with the subcutaneous test returns to normal in forty-eight hours. In cases complicated by frequent and prolonged vomiting, the absorption from the subcutaneous tissues is at first accelerated, an indication of a dehydration of these tissues. However, if vomiting continues until the volume of the blood is diminished by the severe dehydration so that the blood pressure falls and the peripheral circulation is diminished, the absorption rate may be prolonged above normal. In such cases fluid should be supplied directly to the blood by intravenous administration, until the absorption from the subcutaneous tissues becomes normal (or is slightly accelerated). Fluid may then be supplied by subcutaneous or rectal administration until it is possible to give the necessary amount by mouth.

Another test employed is a modification of the so-called imbibition test of Labbé and Violle, in which the gastrocnemius muscle of a frog is placed in the serum to be tested. In normal serum it loses a part of its weight (because of loss of fluid) in the first few hours and then regains it within forty-eight hours; in serum from a subject with edema, it constantly gains weight, because of actual imbibition of fluid by the intramuscular connective tissue. In clinical cases, the author has found it necessary to use whole blood with potassium oxalate (not over 2/1000) as an anticoagulant, as with the amount of serum obtainable changes are sometimes too slight to be correctly measured. The muscle to be weighed is freed from the red cells by repeated washing in the plasma of the patient on whom the test is made. The results of this test are in complete agreement with those of the subcutaneous absorption test. The slight dehydration of the blood after uncomplicated operations on patients in a normal state of hydration is evidenced by the fact that the frog muscle in the blood of such patients at first loses a larger percentage of its weight than in normal blood, i.e., loses a larger amount of its fluid because of a slight dehydration of the blood, but this is shortly regained. In the blood of patients whose condition after operation is complicated by vomiting with consequent loss of fluid, the frog muscle loses a still larger percentage of its weight at first, and continues to lose weight for a long period of time (several days), an indication of a more severe degree of dehydration of the blood which is not compensated for by rapid absorption from the tissues. This confirms the author's conclusions from his first series of tests, that in cases of severe postoperative dehydration fluid must be supplied directly to the blood by intravenous administration until the blood volume and the peripheral circulation are restored to normal.

ALICE M. MEYERS.

Lehmann, K.: Clinical and Experimental Studies on Intestinal Paralysis in Extra-abdominal Traumatic Injury to the Trunk. *Acta chirurg. Scand.*, 1939, 81: 439.

The author reviewed a series of 497 patients with such different injuries as fractures of the ribs, vertebral column, and pelvis, as well as contusion of the back, and injury to the kidney, and noted that intestinal paralysis occurred in 11 cases.

The most characteristic feature in these cases was the marked, often violent, degree of meteorism that developed rather unnoticed, almost insidiously, from the second or third day after the accident. There were no precursory abdominal symptoms, so that one could almost say that there was a free interval or latent period between the time of the accident and the appearance of the marked abdominal distention. However, neither the general condition of the patient nor the pulse were affected particularly, and vomiting was relatively rare. It was very difficult to re-establish intestinal peristalsis, and in 1 case there was a fatal outcome. This patient was a man sixty-six years old who suffered a relatively slight injury to the back, without any demonstrable fractures, who then had a violent paralytic ileus and died in spite of enterostomy performed on the fifth day after the accident. Autopsy revealed nothing abnormal in the abdomen except marked distention of all sections of the small and large intestines, without any demonstrable mechanical cause. The only abnormality found was a large right paravertebral hematoma ex-

tending from the ninth to the twelfth ribs. In addition there was a hematoma between the posterior surface of the vertebral bodies and the posterior longitudinal ligament throughout the removed part of the vertebral column (from the seventh dorsal to the fourth lumbar vertebræ). The spinal cord was normal.

It is suggested by the author that the paravertebral hematoma might have had an irritative effect on the splanchnic nerves and sympathetic chain, which because of their inhibitory effect on intestinal peristalsis might have produced intestinal paralysis.

In 8 of the 11 cases reviewed by the author, it was found that the injury was located supradiaphragmatically in this very region around the origin of the splanchnic nerves. He explains the fact that intestinal paralysis in lesions of the trunk above the diaphragm is relatively more frequent than when the lesions are in the lower part of the body, on the basis of the anatomical arrangement of the spinal ligaments and the retroperitoneal and retropleural tissue spaces. The relationships between those structures and the sympathetic plexuses are described and illustrated in detail in the article.

Animal experiments which appear to show that hematoma around the splanchnic nerves and the sympathetic chain is able to produce intestinal paralysis are also presented.

The author believes that the operation of enterostomy performed in his fatal case was irrational, because of the fact that the entire intestine was paralyzed. He states that perhaps lumbar anesthesia would have produced a better result, as then the sympathetic fibers to the intestine would have been paralyzed and, perhaps, peristalsis might have been re-established.

He recommends, therefore, in those cases of traumatic paralytic ileus in which the condition becomes so threatening that it does not seem safe to wait longer, that a local injection of novocain be made into the hematoma, as is done in the reduction of vertebral fractures or in lumbar anesthesia.

SAMUEL H. KLEIN, M.D.

Babcock, W. W.: The Prevention and Management of Postoperative Intestinal Incompetence. *Surg. Clin. North Am.*, 1938, 18: 1599.

By intestinal incompetence Babcock refers to inadequate motor, secretory, or absorptive capacity of the bowel. Obviously the common conditions are those resulting in partial or complete obstruction, but excessive peristalsis and diarrhea also express relative incompetency. He refers to certain reflex gastro-intestinal arcs, such as the ileopyloric reflex, in which irritation about the ileocecal valve results in pylorospasm, consequent gastric retention, and accumulative hyperchlorhydria. Familiarity with the gastro-intestinal expressions of cardiovascular, pulmonary, renal, or pelvic disease, as well as of tabes, herpes, psychoneurosis, hyperthyroidism, plumbism, and the like, may prevent serious errors in diagnosis and treatment.

Babcock believes that drastic purgatives and repeated enemas, which have been used for many years, preceding the operation, as well as the calomel and saline laxatives administered after the operation, have created much postoperative vomiting, cramps, and tympany. He does not believe that the various drugs injected subcutaneously to stimulate the laggard bowel, such as strychnine and eserine are of any value.

After the exposure and trauma of an abdominal operation, two or three days of rest usually are required for the gut to regain its normal function. During this period aggressive stimulation is harmful. Laxatives may provoke vomiting and distention, and enemas are usually ineffective and cause discomfort. If a rectal tube is used it should be a well lubricated small catheter. Babcock believes that as long as inadequate attention is given to the avoidable causes of postoperative intestinal incompetence, it is evident that the temptation to use peristaltic tonics will recur. If used, they should be used with much circumspection, and never if there is peritonitis or organic obstruction.

The author has seen patients in whom the appendiceal stump was blown out, and perforating ulcers of the intestine have been observed in patients in whom such injections were used. Unnecessary and unanatomical incisions, while not so common as formerly, are still observed. Instead of excising an old scar with its defects and adhesions the operator makes a new one with a new line of denuded tissue to fuse with underlying intestinal structures. Babcock believes that if the peritoneal tears and the muscle come in contact with bowel, an important source of adhesions is left. Such peritoneal separation is most easily prevented by transverse or oblique incisions. He does not believe in the use of amniotic fluid or ferments as a routine treatment for the prevention of peritoneal adhesions. Retained blood and clots in the peritoneal cavity provide culture media for bacteria and a matrix for organized adhesions. Suture and ligature material may produce a decided reaction in the wound. This is true particularly of catgut to which some persons may be susceptible, while wounds sutured with silk or rustless steel wire heal more rapidly, with greater strength, and less tissue reaction.

The author decries the use of rubber and gauze drains. He prefers non-soluble, pyrex glass of large diameter, to which there is little plastic reaction. These glass tubes from 2½ to 5 cm. in diameter, which he calls "lamp chimney drains," are anchored to the wound but float in the peritoneum. He believes that swallowed air is the chief ingredient of gases present in the gastro-intestinal tract during the postoperative period. Persistent eructation should be treated by suction drainage or an anchored cork between the teeth. He believes that most patients do far better if visitors and sympathetic members of the family are not permitted to see them. Fruit juices, fats, coarse foods, and those to which the patient is allergic should be avoided.

Asafetida rectal suppositories, and small enemas of the milk of asafetida have some value in the prevention of colonic distention. The Wangensteen type of gastroduodenal suction is advantageous in postoperative ileus, but the Miller-Abbott tube should be reserved for a few special cases. Babcock by far prefers multiple enterostomies and colostomies in the presence of ileus from peritonitis. He believes that enterostomy is perhaps the most useful operation for postoperative ileus. For the performance of the enterostomies, he uses evipal combined with local anesthesia.

WILLIAM C. BECK, M.D.

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Abel, J. J., Firor, W. M., and Chalian, W.: Researches on Tetanus. IX. Further Evidence to Show That Tetanus Toxin Is Not Carried to Central Neurons by Way of the Axis Cylinders of Motor Nerves. *Bull. Johns Hopkins Hosp.*, Balt., 1938, 63: 373.

The chief arguments that have been brought forward in support of the theory of Meyer and Marie were subjected to a detailed analysis, and evidence is offered to show that tetanus toxin is not carried to the central nervous system by way of the peripheral nerves, but is transported throughout the body by the blood and lymph vascular systems. The toxin of clostridium tetani is thus brought into line with countless other noxious agents for which it has not been necessary to assume a special mode of conveyance by the components of peripheral nerves. The following theory, which was set forth in previous publications, is upheld: the toxin exhibits both a central and a peripheral action, each of which may be demonstrated independently of the other. The central effect, which is characterized by reflex motor convulsions, is due to the poisoning of the motor nerve cells of the spinal cord, medulla, and pons; the peripheral effect, recognized as the unremitting rigidity of voluntary muscles, results from the fixation of the toxin upon the motor end-organs. Evidence of the rapid fixation and subsequent immobilization of the toxin is afforded by the consequences of the injection of very small quantities of the toxin into the anterior horns of the spinal cord and, by the method of multiple intramuscular injection, into a front or hind leg.

The defenders of the axis-cylinder method of conveyance have failed to explain in a satisfactory manner why in local tetanus only one of the two cardinal symptoms of tetanus—an enduring muscular rigidity—appears, while in general tetanus, when the toxin can travel only by way of the same centripetal axis-cylinder route as in local tetanus, both muscular rigidity and an increased reflex excitability appear.

Even when the sciatic nerve is blocked with adequate antitoxin, local injection of the toxin into the muscles results in the same amount of local tetany as when no antitoxin has been injected. It is theoretically possible to throw all of the striated muscles into tetany by the use of .05 of the dog lethal dose administered intramuscularly.

The conclusions adduced from this work tend to refute the recent work of Doerr and his associates who attempted to prove the validity of the older theory of Meyer, that the toxin made its way to the central nervous system via the axis cylinders.

JOHN WILTSIE EPTON, M.D.

ANESTHESIA

Gross, R. E.: The Use of Vinyl Ether (Vinethene) in Infancy and Childhood. *New England J. Med.*, 1939, 220: 334.

The author employed vinyl ether as a general anesthetic in a series of 100 infants and children ranging from one month to eleven years of age. This drug was extremely satisfactory for minor operative procedures, and in no case was there any alarming or untoward reaction accompanying or following the anesthesia. The extremely rapid induction period with this drug permitted full muscular relaxation in from thirty to forty-five seconds. The period of recovery was likewise short, and in practically all cases the patient had regained consciousness in two or three minutes, and older children were talking and sitting up by the end of this time. There was postanesthetic vomiting in only 5 cases.

Vinyl ether can be administered in a closed gas machine, mixing the vaporized drug with oxygen; but since the operation in which the anesthetic should be employed is a short one, this method of administration is somewhat cumbersome. The drug can be given easily and quickly on an open mask, and when thus employed in the reported series it was always satisfactory.

The author concludes that vinyl ether appears to be the safest and most satisfactory general anesthetic yet produced for operative procedures of from five to ten minutes' duration in infancy and childhood. The cost, which ranges from 25 to 40 cents for an average dose, is moderate.

JACOB M. MORA, M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Moller, P. F.: Chronic Fluorine Poisoning Seen From the Roentgenological Standpoint. *Brit. J. Radiol.*, 1939, 12: 13.

Chronic fluorine poisoning in man was first demonstrated by roentgenological diagnosis. In the course of some investigations for silicosis in workers in a cryolite factory, the author in 1931 discovered bone changes in a number of the workers differing from those of any known disease. In connection with these changes, various clinical and pathological findings corresponding to those described by Brandl and Tappeiner in dogs when chronic fluorine poisoning was produced in them experimentally were noted. Cryolite contains a high percentage of fluorine and investigation disclosed that it was the swallowing of the dust of this chemical which was responsible for the changes noted.

Although most of the individuals affected had gastro-intestinal, chest, and muscular symptoms, the principal sign of the poisoning was the change in the bones. These changes were mainly in the form of an osteosclerosis involving primarily the bones of the pelvis and spine, but practically all bones showed changes of various degrees in some cases. Normal bone structure was replaced by a dense woolly indistinctness and points of muscular or ligamentous attachments showed excrescences due to extensive calcification, which sometimes extended into the ligaments. The degree of sclerosis was dependent upon the length of exposure, appearing at the earliest after two and one-half years. Roentgenological findings have been corroborated by post-mortem examinations.

Research work in connection with fluorine poisoning has revealed a much larger rôle in biology for that element than has been suspected. It has been found present in widely separated regions in various combinations. It may exert poisonous effects in drinking water, and in plants which are eaten, and if it is swallowed in dust or inhaled in gases. Degenerative dental changes, resulting in so-called "mottled teeth" have been shown to be caused by it, and osteoporosis or osteomalacia in animals has been produced with it. In view of the established facts, it is apparent that prophylactic precautions are required to guard against the harmful effects of fluorine in industry and also in private life.

ADOLPH HARTUNG, M.D.

Ragheb, M.: The Radiological Manifestations in Bilharziasis. *Brit. J. Radiol.*, 1939, 12: 21.

In bilharziasis, ova are commonly deposited in the submucosa of the urinary and gastro-intestinal tracts and cause ulceration and calcareous deposits, or the formation of papillomas which may ulcerate or become calcified and be revealed roentgenologically. The ulceration and deposits are predominant in the urinary bladder, ureters, and seminal vesicals, whereas the papillomas are usually found in the intestines and kidneys. When calcification is present the changes are readily demonstrable, otherwise the introduction of opaque material is necessary for their visualization.

Papillomas in the large intestines rarely calcify except in the region of the appendix where they may present as small rounded or club-shaped calcareous shadows. In the urinary tract the calcification of papillomas is common and the fact that they undergo little or no change of position or size on repeated examinations even after long intervals usually serves to differentiate them from urinary calculi.

The bladder, as a rule, is the first organ to give evidence of bilharzial infection. Calcifications may vary from thin lines involving limited portions of the wall to heavier shadows completely outlining the organ. Depositions in an irregular manner may cause dense bands within the boundaries. In advanced chronic cases contraction occurs and the shadow may resemble a large calculus except that it is almost always of irregular density. Similar changes take place in the ureters. If the vesical openings become occluded, dilatation of the proximal passages takes place. They may be outlined in their entire extent by calcifications. In the pelvis of the kidney papillomas may be demonstrated by pyelography.

Bilharzial infection of the seminal vesicles is seen in relatively few cases. When present it usually involves the vesicles in their entirety and presents a tapering cluster of small, adjacent and close, rounded calcifying masses, diminishing in size as they approach the tapering end.

Involvement of the colon is most apt to occur in the pelvic part and sigmoid. In the early stages evidences of spastic colitis only are demonstrable, but later when the papillomas become larger and more numerous, the opaque enema reveals rounded areas of filling defects in close proximity to each other.

Numerous roentgenograms are included, illustrating the conditions described.

ADOLPH HARTUNG, M.D.

Westermark, N.: The Roentgen Diagnosis of Primary Tumors of the Lung. *Acta radiol.*, 1938, 19: 505.

The author divides the radiographic findings in bronchostenosis into three stages: (1) slight stenosis producing slightly diminished aeration and hyperemia peripheral to the stenosis, visible in the radiograph as a lightly diffuse opacity: (2) marked stenosis producing emphysema and anemia peripheral to the obstruction; this area appears as a translucent region in the radiograph: (2A) a tran-

sitory stage between the foregoing groups, characterized by inspiratory density and expiratory clarification: and (3) complete occlusion producing obstructive atelectasis and hyperemia peripheral to the stenosis, evidenced as a massive wedge of opacity in the radiograph.

Although benign tumors of the bronchi are very rare, polyps, fibromas, papillomas, lipomas, myomas, adenomas, and chondromas have been described. These benign tumors produce bronchostenosis; by bronchography they are found to cause smooth rounded protrusions into the bronchial lumen. Differential diagnosis from enlarged mediastinal glands or mediastinal tumors may be difficult.

Chondromas are the most common benign tumors of the lungs. They present a well localized rounded or somewhat irregular massive shadow in which irregularly mottled calcifications can usually be distinguished. Differential diagnosis from echinococcus cysts is dependent upon the absence of capsular calcification and of subphrenic lesions, which are found in the latter.

The author has studied 55 cases of bronchial carcinoma and has proved that the incidence of bronchial carcinoma as compared to carcinoma of the stomach has definitely increased in recent years. The ages of his patients have varied from thirty-eight to seventy-seven years and more than half have been under fifty years. He has found bronchial carcinoma to occur five times as often in men as in women. The right lung is involved three times as often as the left. The lower lobes have been involved somewhat more frequently than the upper lobes and when the lower lobes have been involved the cancer has been located in one of the dorsal branches. Three types of tumor have been seen: those localized to the bronchial wall; those diffusely infiltrating the lung, and those located in the middle of a lobe. Tumors originating from the bronchial wall are soft nodular or papillary tumors occluding the lumen, or localized stenosing infiltration of the bronchial wall. The tumors which form a diffuse infiltration may affect all or the major part of a lobe. The circumscribed tumors in the middle of a lung lobe are usually relatively benign and extend expansively into the lung, being often surrounded by a capsule.

In 53 of the 55 cases seen by the author bronchostenosis was the first symptom; 16 showed valvular stenosis and 37, complete bronchostenosis with obstructive atelectasis. The diagnosis of tumor necessitates a bronchographic examination. At St. Göran's Hospital the pharynx and hypopharynx are anesthetized with 2 per cent pantocaine, following which from 2 to 5 c.cm. of iodized oil are injected. In the bronchograph the tumor appears as a continuous filling defect with stiff and torn outlines causing variable degrees of stenosis of the lumen. If stenosis is complete the filling defect assumes the shape of a stiff and torn cornet which may encroach upon several adjacent bronchial branches.

Sarcomas form more or less rounded tumors which may occupy a whole lobe or an entire lung; their growth is expansive. Radiographic studies reveal a massive homogenous shadow in the center of a lobe, occupying an entire lobe or an entire lung.

HAROLD C. OCHSNER, M.D.

RADIUM

Engel, D.: An Experimental Study of Radium on Developing Bones. *Brit. J. Radiol.*, 1938, 11: 779.

Previous experiments by the author revealed that spinal curvatures could be produced in developing goats, dogs, and rabbits if the epiphyseal cartilage of one-half of one or several vertebral bodies was destroyed with radium therapy. In the present experiments rabbits were used. Four to twenty-five day-mgm. of radium were applied in the form of 5 tubes of 1 cm. length, and 1-mgm. needles of 2 cm. length, filtered with ½ mm. of platinum. The needles were fixed to the skin with adhesive plaster or transfixed through the skin and applied to the bone directly. Usually one posterior extremity was used. The ages of the animals at the time of irradiation varied between three and ten weeks. Radiographic examination was made one, three, and six months after treatment. A post-mortem examination was made in each case, and detailed protocols are given.

In every rabbit to which a sufficient radium dosage was applied and which was observed for a sufficient period, the treatment resulted either in shortening of the extremity or deformity, or both. The results depend upon three factors: the age of the animal, the dosage of radium, and the technique of irradiation. The younger the animal was, the greater the bone shortening; the greater the dosage, the greater was the degree of retardation of growth; and the more direct the contact of the needle with the bone, the greater was the reaction. The more highly developed an animal was from the phylogenetic standpoint, the more sensitive was its cartilage.

The authors believe that the response of the epiphyseal cartilage is so constant as to merit the proposal that this response be utilized as a test of the biological effect of radium. The epiphyseal cartilage responds first with an arrest of growth, which is followed by a transitory stage of over-production, and finally with arrested growth.

HAROLD C. OCHSNER, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Roelsen, E.: The Composition of the Alveolar Air Investigated by Fractional Sampling. *Acta med. Scand.*, 1939, 98: 141.

The composition of the alveolar air was examined by means of fractional sampling. Thirty-seven experiments were performed on 13 subjects with sound lungs. The mode of procedure was as follows:

Immediately after an ordinary respiration experiment, in which the expiration air was collected in a Douglas bag and the respiration volume, respiration rate, and the oxygen metabolism were determined, the test subject rapidly expires into a spirometer to the residual air, samples of the alveolar air being taken simultaneously with Sonne and Nielsen's glass slish. The apparatus used in these experiments and the method of calculation are illustrated and described in detail.

The author found that the average decrease of alveolar oxygen amounts to .24 per cent per second (.26 per cent per second per liter), whereas the respiratory quotient in expiration air indicates that alveolar air undergoes a decrease of .012 per second. In the majority of cases the graphic reporting of the decrease of alveolar oxygen showed the greatest decrease of percentage in the beginning of the expiration, whereas during the termination it became less marked, and sometimes was even replaced by an increase of the alveolar oxygen percentage. The percentages of alveolar oxygen and alveolar CO_2 were from 13 to 15 per cent and from 5 to 6 per cent, respectively, on an average.

A comparison beween the decrease of alveolar oxygen per second observed, and the decrease of oxygen calculated under the assumption of homogeneous alveolar air and of equal blood circulation through the lungs reveals insufficient agreement. This is due to the fact that the basis of the calculation is not valid, as might partly be expected considering the results of the hydrogen experiments previously published by the author. A calculation of the decrease of the alveolar oxygen, performed under the assumption of inequality of ventilation and of equal blood circulation in the lungs, frequently yields a greater decrease of the alveolar oxygen than that actually found in the experiments. This is suggestive of inequality not only in the ventilation of the lungs, but also of their blood perfusion. Some experiments, because of a marked decrease of the blood perfusion of certain hypoventilated sections of lung, reveal a rise of the alveolar oxygen percentage during the termination of the maximal expiration.

Similar serial experiments were performed on 17 patients with asthma and emphysema, in 5 of whom, however, the emphysema was dubious. The average decrease of alveolar oxygen amounts to 0.73 per cent per second (1.36 per cent per second per liter), whereas the respiratory quotient in the expiration air and alveolar air decreases by .05 per second. The decrease of alveolar oxygen which deviated considerably from the normal, and the considerable decrease in the respiratory quotients in the expiration air and alveolar air are adequately explained by the very unequal lung ventilation in emphysema patients.

The alveolar oxygen percentages are often normal, and sometimes somewhat low (from 11 to 13 per cent and, occasionally, about 10 per cent), whereas the CO_2 percentages in the majority of cases are normal (from 5 to 6 per cent), and in one of the author's patients amounted to about 7 per cent.

A comparison between the present examinations of the alveolar air and previously published hydrogen examinations shows that the blood perfusion of the hypoventilated sections of lung certainly is greatly reduced in emphysema patients.

Because varying samples of alveolar air from one and the same expiration vary widely, one must be careful in calculating the dead space on the basis of isolated alveolar air values.

The importance of very unequal lung ventilation for the pathogenesis of dyspnea in patients with asthma and emphysema is also discussed.

Generally there is found fairly satisfactory agreement between the magnitude of the decrease of alveolar oxygen and the clinical condition of the patients. For the estimation of the clinical condition the decrease of the alveolar oxygen is not very suitable, however, because the examination permits of too many sources of error. The influence of the pulmonary circulation, no doubt, plays an uncontrollable part in the magnitude of the decrease of the alveolar oxygen. SAMUEL H. KLEIN, M.D.

Allen, F. M.: Physical and Toxic Factors in Shock. *Arch. Surg.*, 1939, 38: 155.

It is possible to distinguish theoretically three entities included in the present interpretation of the word shock. One of these is the neural injury which may partly be defined as to anatomical lesions and physiological effects, such as reduction of the blood pressure, and may appropriately be covered by the term "shock" because of its vagueness, and the logical relation to the original meaning of the word.

The second is the other element which is often assumed to exist in primary shock, namely an influence of the injured tissues apart from the nervous injury. Neither the nature nor the actual existence of this element has been positively demonstrated, but it should be subject to investigation in tissues separated from their nerve connections, and the part played by circulatory factors, dehydration, temperature, infection, tissue toxins, or anything else should be definable.

The third is the condition now called secondary shock; and since this is recognized as being entirely different from primary shock and also a departure from the everyday meaning of the word shock, a replacement of this clumsy designation by something more definite seems desirable. While the evidence obtained in the present investigation is unfortunately only indirect, it at least suggests some such provisional name as histotoxicosis.

The vasomotor and other phenomena may thus be conceived as resulting from nervous and humoral agencies, which supplement each other as in so many other physiological processes. This hypothesis at least offers a rational explanation of the entire range of events, classifiable in three degrees: (1) injury, such as a small contusion or burn, in which the combined nervous vasodilation and histotoxin production cause only local redness and swelling without appreciable constitutional effects; (2) more extensive damage, involving primary general vasomotor disturbances of nervous origin and the formation of greater quantities of histotoxin, which not only augment local transudation but also escape into the circulation and set up similar processes throughout the body (this loss of fluid, however, can still be compensated for by administration of sufficient fluid); and (3) still more extensive or intensive damage, in which either the primary nervous disturbance or the secondary production of histotoxin may be fatal in spite of the preservation of fluid balance at all stages.

The final demonstration and designation must be left to the chemist, who may be able to identify the hypothetic histotoxin. Local asphyxia may be regarded as the ideal method for this study because of the simple and accurate control, exclusion of the nervous factor by the ligation, absence of dead or dying protoplasm, avoidance of other complications, and the possibility of full recovery of the animals when desired. There may be conjecture whether the condition of secondary shock, or histotoxicosis, uniformly originates from asphyxia in the sense that injuries may disturb cell respiration.

Regardless of this speculation, the proved fact that this condition can be caused by tissue asphyxia supports the opinion that a variety of conditions, including infection, hemorrhage, dehydration, circulatory or respiratory failure, or any prostration severe enough to cause a certain deficiency of blood supply in any part or throughout the body, may give rise to asphyxial histotoxicosis, and that the clinical difficulty of distinguishing these states sharply from the so-called secondary shock may be due to an essential and inevitable mingling of the conditions.

The most distinctive characteristic of secondary shock is the increased concentration and reduced volume of the blood, caused by migration of the fluid into the tissues. The changes in the red-cell content are the most quickly and easily ascertained index of this process. Temporary local asphyxia of limbs or other tissue masses appears to offer the best experimental means for producing this condition, because of its simplicity, its accuracy of control, its freedom from complication by tissue necrosis and other conditions, and the opportunity it affords for studying various details.

Traumas which typically produce primary shock, repeated during a period equal to that within which secondary shock is able to manifest itself, fail to cause the characteristic blood changes of secondary shock, thus corroborating the view that the two conditions are radically different.

The effects of local asphyxia, as regards both changes in the blood and the attendant symptoms and death of the animals, can be prevented by sufficiently early amputation of the asphyxiated parts, as is already known of similar operations on the human being. Amputation does not save the life at a later stage after more advanced changes in the blood have occurred.

The following therapeutic observations have been made with various methods of replacement of the migrated fluid:

1. Animals at the point of death may be revived with transfusions of whole blood, while separated corpuscles or plasma have less value, and saline solution has practically none. Such recovery is always brief, and no amount of the fluids mentioned saves life at this stage.

2. Death, which regularly occurs under certain standard conditions, e.g., after five or six hours of asphyxia of one hind leg of a rat, is preventable by means of early transfusions with blood or plasma, not with corpuscles. These results, and those under 1, agree fully with the clinical evidence of the value of transfusions of blood or plasma to compensate for the loss of circulating fluid under certain conditions in shock. An equivalent benefit from acacia solution was not demonstrable.

3. The results mentioned under 1 and 2 are obtained practically as well with the blood of animals dying in shock as with normal blood. This disproves the existence of any considerable amount of toxin in the circulation.

4. After asphyxia of extensive masses of tissue, transfusions of blood or plasma no longer suffice to save life, even though the corpuscle count is kept at a normal or reduced level and all indications point to normal or increased blood volume, together with adequate propulsion of the blood. Theories which regard these factors as determinative in shock are thus invalidated.

5. In the conditions described under 4, simple injections of saline solution are able to save life when plasma fails. It is deduced that the essential physical factor is the obligatory edema or avidity of the tissues for fluid, and that the most important requisite in treatment is a fluid which will pass easily out of the vessels to satisfy this need. When this is supplied, the plasma automatically remains in the vessels. The composition of the blood and the animal's life are preserved, notwithstanding abnormal permeability of the vessels or other changes.

6. After more intensive, i.e., more prolonged asphyxial, injury of the tissues, death occurs in spite of injections of saline solution which prevent the rise of the corpuscle count and maintain the gross appearances of adequate filling and circulation in the vessels. It seems possible that the composition of either the blood or the tissues is altered to a fatal degree.

7. Various therapeutic attempts along other lines than fluid replenishment have failed, so that the physical hypothesis must be credited with suggesting the only helpful form of treatment.

The effects of local asphyxia, as regards changes in the blood, symptoms, and death, are augmented by heat and inhibited by refrigeration of the parts during asphyxia.

On the basis of the evidence in favor of the toxic hypothesis, it is suggested that a substance or substances derived from the injured protoplasm may be a highly important factor affecting the vascular permeability, edema formation, and other symptoms. The use of such a term as histotoxicosis is, therefore, suggested provisionally.

SAMUEL KAHN, M.D.

Cecil, R. L., and Angevine, D. M.: Clinical and Experimental Observations on Focal Infection, with an Analysis of 200 Cases of Rheumatoid Arthritis. *Ann. Int. Med.*, 1938, 12: 577.

In this paper, the term "rheumatoid arthritis" is used to describe the picture of a chronic, progressive, inflammatory disease of several joints, which is characterized in the early stages by periarticular swelling and fusiform fingers, and in the later stages by ankylosis and deformity.

The authors review a series of 200 clinical cases of "chronic infectious arthritis," which Cecil and Archer reported in 1927, with special reference to the incidence of focal infection. In this report, focal infections appear to have been very common, and the removal of foci, especially when carried out early in the disease, seemed to produce beneficial results in a good proportion of cases. Today, the authors would probably omit many of the cases as not fulfilling the criteria of rheumatoid arthritis, and in view of present knowledge it is possible that a good many patients would have shown improvement even if the foci had not been removed.

In contrast with this series, they present an analysis of a group of 200 cases of typical rheumatoid arthritis, taken from records in the private practice of Cecil. No case has been included that did not fulfill the classical pattern of the disease. For example, every case in the series showed, or had shown at some time previously, several characteristic fusiform fingers which, in the authors' opinion, are a typical manifestation of this syndrome. The sedimentation rate was accelerated in 93 per cent of the patients, and the agglutination reaction with a strain of hemolytic streptococcus was strongly positive in 65 per cent. There was definite evidence of infection in 20 per cent and a questionable focus in 10 per cent. Seventy per cent of the patients revealed no demonstrable focus of infection.

Experimental work was performed on rabbits in an attempt to produce foci of infection and arthritis. From these studies, the following information was obtained:

1. Arthritis was produced in only 11 of 100 rabbits which were given injections by other than the intravenous route. To accomplish this it was necessary to use large doses of a suitable strain of streptococcus, as well as a most susceptible animal.

2. Arthritis developed only in those animals from which streptococci were recovered from the blood stream shortly after the injection.

3. In rabbits the gums were a particularly favorable site for the absorption of bacteria.

4. Repeated injections of bacteria caused no more arthritis than a single injection.

5. It was difficult to establish a chronic, persistent focus of infection in rabbits.

The authors stress the point that, in the final analysis, the decision regarding the eradication of so-called foci of infection should be made by the internist rather than by the specialist, and that physicians should exercise a more conservative attitude than they have in the past regarding the treatment of tonsils, teeth, and sinuses in rheumatoid arthritis.

A complete revaluation of the focal infection theory is necessary. Undoubtedly, there are cases of infectious arthritis which result from focal infection. However, as far as typical rheumatoid arthritis is concerned, it would appear from this study that chronic focal infection plays a comparatively unimportant rôle. SAMUEL H. KLEIN, M.D.

DUCTLESS GLANDS

Fana, C.: Experimental Researches on the Endocrine Function of the Mammary Gland. The Action of Mammary Extracts on the Genital Tract and on the Glands of Internal Secretion (Ricerche sperimentali sulla funzione endocrina della mammella. Azione di estratti mammari sul tratto genitale e sulle ghiandole a secrezione interna). *Folia demograph. gynaec.*, 1938, 35: 419.

The action of extracts of the mammary gland on the genital tract and the endocrine system in general has been studied enough in the past years to indicate that the mammary gland takes on the rôle of an endocrine organ. This function was suggested first in 1896 by Bell and others. The author presents a brief review of the literature.

The purpose of the experiments reported was the study of the histological modifications in the genital and endocrine glands and of the importance of the ovaries in the determination of these changes.

Fana noted that mammary extracts stop the estrus cycle in white rats and induce a sudden atrophy of all the tissues in the uterine ovarian regions. The lining membranes become particularly hypoplastic. In the

guinea pig similar changes are noted. In addition there are degeneration of the ovaries, hypertrophy of the adrenal cortex, hypertrophy and hyperplasia of the thyroid, and hyperplasia of the anterior lobe of the hypophysis. In general, Fana noted that the ovaries must be present in order for these changes to take place. Castration, however, does not modify the changes in the uterus particularly.

Clinically, mammary-gland extracts have been of help in the decrease of the vascularity of the utero-ovarian regions, as in menorrhagia, fibrosis uteri, and subinvolution of the uterus.

A. Louis Rosi, M.D.

Adler, H.: The Physiology and Pathology of the Thymus Gland. Clinical Experiments (Physiologie und Pathologie des Thymus. Eine klinisch-experimentelle Studie). *Deutsche Ztschr. f. Chir.*, 1938, 250: 614.

This is a very interesting, informative, and suggestive work. From Hammar's fundamental morphological investigations, it appears that the size of the thymus has up to the present been generally underestimated. In young persons it is comparatively large, with a well developed system of lymphatic glands. In spite of physiological involution, all thymus-cell forms were found in extreme old age. We still have no clear understanding of the physiology of the thymus, notwithstanding the large amount of work that has been done to explain it. It may be that it contributes growth-furthering influences. However, the trephones to which such influences have been attributed are found also in lymphatic-gland extracts. That removal of the thymus is followed by a disturbance in growth is affirmed by some investigators and denied by others; but relations to the endocrine organs, the sex organs, the adrenal gland, and the thyroid gland, doubtless exist.

The *thymus gland and myasthenia gravis pseudo-paralytica*. This disease consists of a progressive general fatigability of the skeletal, facial, masticatory, deglutitive, phonatory and ocular musculature, without atrophy or degeneration, and is thus a purely muscular disease. Important for the diagnosis is Jolly's myasthenic reaction; i.e., a tetanic faradic current produces first normal contraction and then rapidly developing fatigability of the muscle. The disease can exist for years; it sometimes shows periods of improvement; but the prognosis is grave because of the possibility of the sudden appearance of paralysis of the muscles of respiration. Recently Walker has shown that improvement lasting for hours can be obtained by the injection of prostigmin. Tumors or hyperplasias of the thymus have sometimes been found; but at the present time the connection remains unexplained. With the thought that there might be a connection with the myasthenia frequent in exophthalmic goiter, Sauerbruch in 1911 removed a thymus weighing 49 gm. from a woman with exophthalmic goiter in whom hyperplasia of the thymus could be demonstrated. The severe myasthenic symptoms disappeared, and one and one-half years later the thyroid gland was removed because of its sudden enlargement. Subsequently, von Haberer reported great improvement in the myasthenic symptoms of patients with exophthalmic goiter following removal of the thyroid and thymus glands. The case of a forty-year-old woman with severe myasthenia who had a tumor of the mediastinum is reported. The injection of prostigmin was followed on every occasion by a sudden improvement in the condition which occurred after a half hour. Sauerbruch removed the tumor. Unfortunately, the patient died of empyema and suppuration of the operative wound. Examination of the tumor showed a benign lympho-epithelial tumor of the thymus.

The author reports 5 series of experiments which he himself conducted on dogs. In the first and second it was demonstrated that typical myasthenic phenomena can be produced by implantation of the thymus gland of young dogs or calves. In the third series pieces of calf's thymus were implanted into the peritoneum, either once or repeatedly, and it was found that the myasthenic phenomena could be relieved by prostigmin injections, just as in man. The blood serum and calcium levels were controlled in all the animals. In no instance did the lymphocytes increase or the calcium content show a change for any length of time. Myasthenia, therefore, has no relation to the change in the blood calcium. In the fourth and fifth series of the experiments, thymus extracts were injected into the vein. They gave rise to immediate myasthenic reactions, which were completely relieved by prostigmin; but lasting clinical pictures could not be obtained by the continuous injection of extracts. That the thymus plays a decisive rôle in myasthenia was therefore proved, and anatomical examinations of the musculature showed, further, that cellular infiltrates in the muscles could not be the cause of the fatigability. Further experiments, described in detail, were made to throw light on the question as to whether hyperactivity of the thymus destroys acetylcholin by means of the irritation of the muscle. This question the author could not decide definitely, but he does explain a mechanism of chemical action. It is certain that the myasthenic disease is of endocrine nature for when the author injected 20 c.cm. of defibrinated blood from a patient with myasthenia into a dog a cystic reaction occurred within a few minutes, which reaction disappeared after the administration of prostigmin.

The causes of hyperfunction of the thymus are infectious diseases, diphtheria, angina, and influenza. The author's studies led him to the hypothesis that the thymus possesses a detoxifying function. The irritations of infection bring about a condition of hyperfunction from which there is no recession to normal. It is probable that the long-continuing muscular fatigue which follows many cases of angina and influenza may be referred to this cause. As treatment, prostigmin is very good, but only if given continuously; the disease itself is not cured. Hence, the indication for thymectomy remains if there is de-

monstrable hyperplasia or tumor. Unfortunately, the demonstration is difficult. Furthermore, hyperfunction need not necessarily produce hypertrophy of the organ. The history is given of a very severe case of myasthenia without demonstrable hypertrophy of the thymus, which began two and a half years previously, after a severe sore throat, and could be only partially relieved by the administration of from 6 to 12 tablets of prostigmin daily. The right lobe of the thymus was removed by Sauerbruch with almost no bleeding by means of a deep collar incision and exteriorization of the organ under traction and with the aid of forceps of the thickness of the little finger. One hour after the operation the patient showed improvement, after six hours she could raise the eyelids to almost the full extent. This favorable condition remained for fourteen hours. After this period some of the improvement was lost, but at the end of three weeks she was able to take long walks and could do needlework without any disturbing fatigue. On the other hand, there was considerable ptosis and the muscles of the face, of mastication, of deglutition, and of phonation continued to tire easily, so that prostigmin had to be given at midday and in the evening to make it possible for sufficient nourishment to be taken. However, in comparison with her previous condition, she is much improved. Removal of the remaining left lobe of the thymus after division of the sternum is being considered.

The thymus and myotonia. It followed from the above related experiences that myotonia or Thomsen's disease might be regarded as resulting from hypofunction of the thymus. A typical case history is reported. The author injected thymus extract and obtained slight but distinct improvement, which, however, lasted only between three and four hours. Further experiments were not made because of the fear that the preparation as obtained from the slaughter house might not be sterile. Intravenous injections of quinine were then given (2 c.cm. of 25 per cent quinine hydrochloride, Bayer). There was a prompt response, which lasted for a few hours (as was reported by Foster Kennedy and Alexander Wolf). Experiments on dogs, made by the author, also produced support for the hypothesis of hypofunction or dysfunction. Dogs were rendered myasthenic by intravenous injections of quinine, but in contrast to dogs made myasthenic by thymus extract, they were not restored to normal by injection of prostigmin. Further investigations are necessary to clear up this question.

The thymus and Addison's disease. Hyperplasia of the thymus is sometimes, but not always, found in Addison's disease. In future, patients with Addison's disease should be tested for the myasthenic reaction.

The thymus and exophthalmic goiter. The incidence of hyperplasia of the thymus in exophthalmic goiter varies between 60 and 100 per cent. In Sauerbruch's clinic it was found in all of the 13 patients who died from this disease over a period of nine years. Von Haberer holds that it plays a decisive rôle in the fate of the patient and, with suitable findings, always recommends thymectomy. Opinions vary as to how the thymus acts in exophthalmic goiter. Since hyperfunction of the thymus can be present without hyperplasia, it became of interest to know, when myasthenic symptoms existed in exophthalmic goiter, whether the myasthenic reaction could be demonstrated and disappeared after operation on the goiter. Twenty case histories are related. The myasthenic reaction was present in 12; in 6 of the 7 cases in which the reaction was sought for in a follow-up examination after operation, it was absent. From this it appears beyond doubt that myasthenia, and consequently hyperfunction of the thymus, exists in a considerable number of patients with exophthalmic goiter. Thereupon the author decided to administer prostigmin (2 tablets, 3 times daily) to a seventeen-year-old girl with exophthalmic goiter and a myasthenic reaction, in whom it had been impossible to obtain improvement in spite of continuous treatment with di-iodtyrosin gynergen, and quinine for four months preceding. In seven weeks the patient made very rapid improvement, with a gain in weight of 8 kgm. The goiter was then removed. There was a very severe reaction, followed, however, by rapid recovery. At the end of two and one-half months she was fully able to work. The myasthenic reaction was negative. This change could have been a matter of chance. It must, further, be determined whether the thymus hypertrophy really has a detoxifying influence, even though it gives rise to myasthenia. Therefore the author now attempts to intensify the hyperplasia of the thymus with thymus extract in patients with very severe exophthalmic goiter. The matter is not yet clear. Nevertheless, these considerations have led to the performance of thymectomy at the time of the goiter operation in patients with exophthalmic goiter and the myasthenic reaction. This has been done three times already. In all the course was remarkably favorable despite the bad previous condition of the patient. The theory formulated at the Sauerbruch clinic is as follows: any increased activity of the thyroid stimulates the internal secretion of the thymus. In exophthalmic goiter, this stimulation is inordinate because of defective central control and the excessive thymic function finds expression in the myasthenic reaction. In some cases this overactivity ceases after removal of the goiter, in other cases it does not. (Franz). Florence A. Carpenter